Aiken Industries
California Instruments
Division

Revision A
JUNE, 1976

INSTRUCTION MANUAL

MODEL 1201T

AC POWER SOURCE

SOLID STATE *Invertron*®

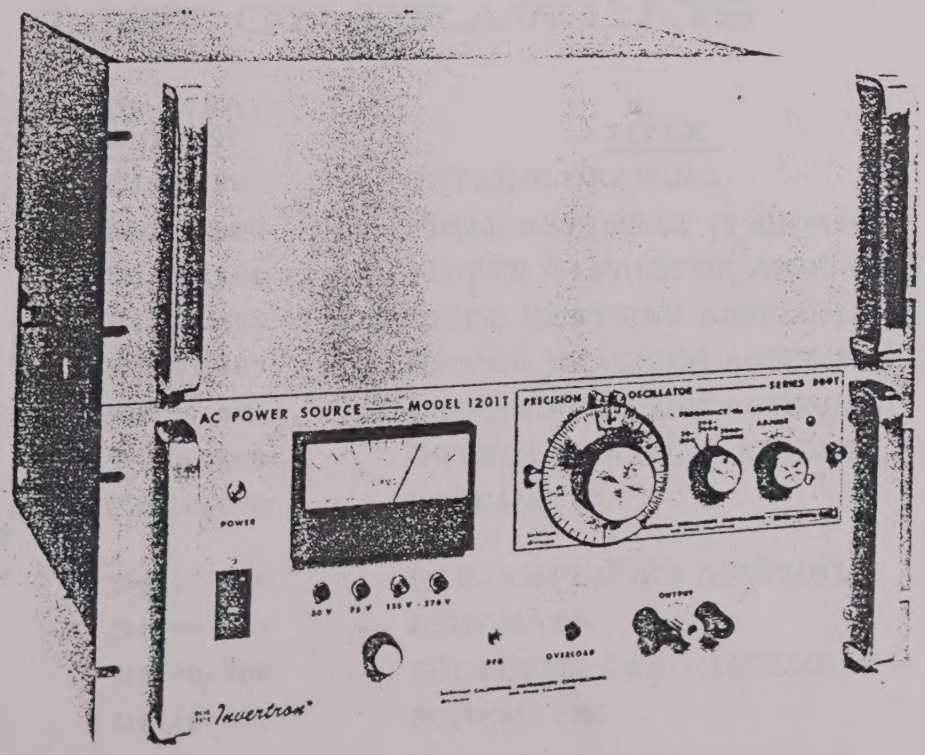


FIGURE 1- 1

LIST OF ILLUSTRATIONS

FIGURE	TITLE	PAGE
1-1	MODEL 1201T PHOTOGRAPH	Frontispiece
3-1	BLOCK DIAGRAM FOR MODEL 1201T	9
4-1	TEST CIRCUIT FOR INITIAL ADJUSTMENTS	20
4-2	ADJUSTMENTS AND TEST POINTS	21
4-3	TEST CIRCUIT FOR MODEL 1201T	26
4-4	LOAD CIRCUIT (0.7 LAGGING POWER FACTOR)	30
4-5	LOAD CIRCUIT (0.7 LEADING POWER FACTOR)	31

TABLE	TITLE	PAGE
2-1	POWER TRANSFORMER PRIMARY WIRING	3
2-2	DERATING OVER EXTENDED FREQUENCY RANGE	7a
3-1	OUTPUT TRANSFORMER SECONDARY INTERCONNECTING	16
4-1	OUTPUT VOLTAGE AND IMPEDANCE LEVELS	18

LIST OF DRAWINGS

ASSEMBLY REFERENCE DESIGNATOR	DRAWING NUMBER	TITLE
None	C4100-900	OUTLINE DRAWING
None	E4100-400	FINAL ASSEMBLY (3 sheets)
A8	E4100-401	FILTER CAPACITOR ASSEMBLY
A7	C4100-402	DIODE HEATSINK ASSEMBLY
A2	E4100-403	DRIVER HEATSINK ASSEMBLY
A4	E4100-404	DRIVER HEATSINK ASSEMBLY
A3, A5	E4100-405	OUTPUT HEATSINK ASSEMBLY
A2, A3, A4, A5, A7, A8, A9	E4120-070	SCHEMATIC
A1	D4100-700	PRE-AMPLIFIER ASSEMBLY
	D4100-071	SCHEMATIC
A9	D4120-700	SELECTOR CARD ASSEMBLY
	D4120-071	SCHEMATIC
A6	C4050-702	METER BOARD ASSEMBLY
	B4050-072	SCHEMATIC

TABLE OF CONTENTS

		PAGE
GENERAL DESCRIPTION		
1.1	INTRODUCTION	1
1.2	GENERAL DESCRIPTION	1
1.3	ACCESSORY EQUIPMENT	1
INSTALLATION AND OPERATION		
2.1	UNPACKING	3
2.2	POWER REQUIREMENTS	3
2.3	CIRCUIT BREAKER REQUIREMENTS	4
2.4	OUTPUT VOLTAGE, METER RANGE AND FRONT PANEL RANGE INDICATOR	4
2.5	ACCEPTANCE TEST PROCEDURE	4
2.6	MECHANICAL INSTALLATION	6
2.7	INPUT POWER WIRING	6
2.8	OUTPUT POWER WIRING	6
2.9	FRONT PANEL CONTROLS	7
2.10	OPERATION OVER EXTENDED FREQUENCY RANGE	7a
THEORY OF OPERATION		
3.1	GENERAL	8
3.2	DETAILED CIRCUIT DESCRIPTION	10
CALIBRATION PROCEDURE		
4.1	GENERAL	17
4.2	TEST EQUIPMENT REQUIRED	18
4.3	INITIAL ADJUSTMENTS	19
4.4	AC LINE INPUT POWER AND OVERLOAD ADJUSTMENT	22
4.5	VOLTAGE, POWER OUTPUT AND HARMONIC DISTORTION	22
4.6	LINE REGULATION	23
4.7	LOAD REGULATION ADJUSTMENT	24
4.8	AMPLITUDE STABILITY	25
4.9	FREQUENCY RESPONSE	27
4.10	AC NOISE LEVEL	27

PAGE

4.11 0.7 LAGGING POWER FACTOR 28
4.12 0.7 LEADING POWER FACTOR 29

MAINTENANCE AND TROUBLESHOOTING
5.1 GENERAL 32
5.2 TROUBLESHOOTING 32

CIRCUIT DIAGRAM
6.1 GENERAL 33
6.2 REFERENCE DESIGNATIONS 33

REPLACEABLE PARTS
7.1 GENERAL 34
7.2 ORDERING INFORMATION 34

PARTS LIST

APPENDIX A

CODE LIST OF MANUFACTURERS

SPECIFICATIONS

MODEL 1201T AC POWER SOURCE

All specifications are tested in accordance with standard California Instruments test procedures and apply with a stable, low distortion input signal as generated by a "T" series plug-in oscillator.

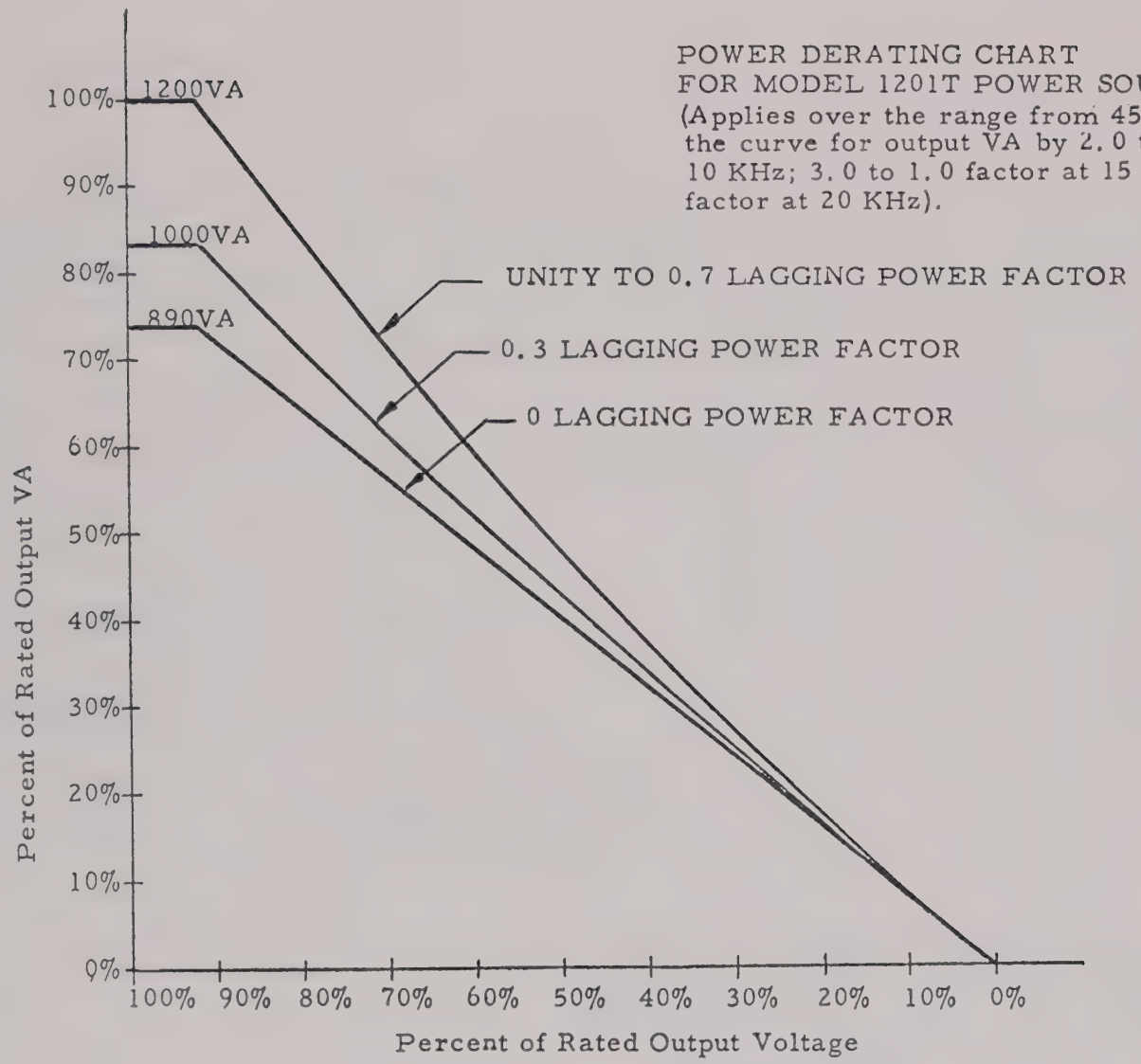
POWER OUTPUT:	1200 VA at 120 to 110 volts rms output with power factor of unity to ± .7. See the derating chart on the following page for operation at lower voltages and/or power factor.
OUTPUT VOLTAGE RANGES: (Determined by rear loaded printed circuit card)	0 to 30 volts rms, 0 to 60 volts rms, 0 to 120 volts rms, and 0 to 240 volts rms.
TOTAL HARMONIC DISTORTION:	Less than 0.3% distortion at mid-band (200 Hz to 600 Hz) and less than 0.5% distortion from 45 Hz to 5 KHz.
AMPLITUDE STABILITY: (after one hour warm-up)	± 0.25% for 24 hours at constant line, load and ambient temperature conditions.
LOAD REGULATION: * (on 120 volt range)	± 1% over the range from 45 Hz to 5 KHz when tested at unity power factor. In addition, a load regulation adjustment permits the regulation to be adjusted to zero at any given line voltage, signal frequency and load conditions. Control resolution is 0.02%.
LINE REGULATION:	± 0.25% of full output for a ± 10% line change.
FULL POWER FREQUENCY RANGE: **	45 Hz to 5 KHz.

* Load regulation degrades slightly on the 30 volt, 60 volt and 240 volt ranges for operation above 1.0 KHz. See Section 4.7.6 of this instruction manual for test procedure on these ranges.

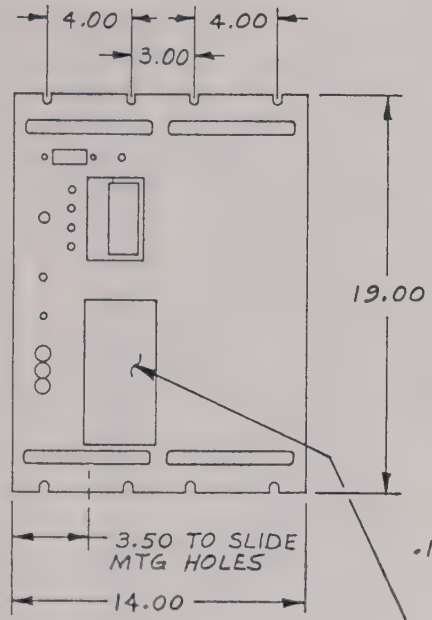
** This power source may be used over the 20 Hz to 20 KHz frequency range provided the output voltage and the output VA are derated according to Table 2-2 in this instruction manual; otherwise, permanent damage to the unit may occur.

FREQUENCY RESPONSE:	± 0.5 dB from 45 Hz to 5 KHz.
AC NOISE LEVEL:	80 dB below full output while measured with a shorted input; 60 dB below full output while measured at full power output.
OVERLOAD AND SHORT CIRCUIT PROTECTION:	Complete protection from overloads and short circuits is provided. Automatic instantaneous reset occurs when overload is removed.
AMPLIFIER DRIVE REQUIREMENTS: (Normally obtained from plug-in)	5 volts rms (maximum) produces 120 volts rms.
AC INPUT LINE:	210 to 250 volts rms. Unit may be wired for the following single phase voltages on special order: 115 V AC, 208V AC, 220 V AC and 240V AC.
AC INPUT FREQUENCY:	48 to 65 Hz. (400 Hz available on special order.)
AC INPUT POWER:	4200 watts maximum under worst case line and full rated load conditions.
OPERATING TEMPERATURE RANGE:	0 to 55°C.
FRONT PANEL METER: (Meter range also controlled by rear loaded printed circuit card)	0 to 40, 80, 160, 320 volts AC voltmeter provides ± 1% of full scale accuracy at 400 Hz and ± 3% of full scale accuracy over the range from 45 Hz to 5 KHz.
DIMENSIONS:	14" high x 19" wide x 21" maximum depth.
NET WEIGHT:	190 pounds.
SHIPPING WEIGHT:	200 pounds.
FRONT PANEL FINISH:	Grey 26440 per Federal Standard 595 with black silk-screened lettering.

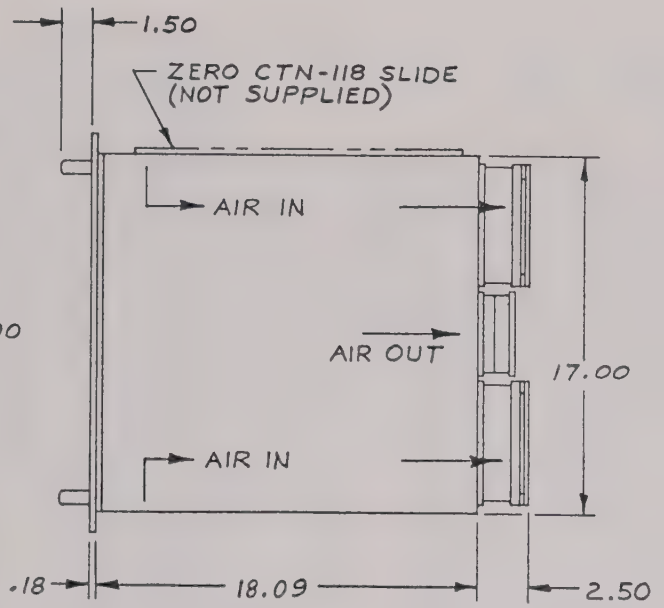
POWER DERATING CHART
FOR MODEL 1201T POWER SOURCE
(Applies over the range from 45 Hz to 5 KHz. Derate the curve for output VA by 2.0 to 1.0 factor at 10 KHz; 3.0 to 1.0 factor at 15 KHz and 4.0 to 1.0 factor at 20 KHz).



REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD

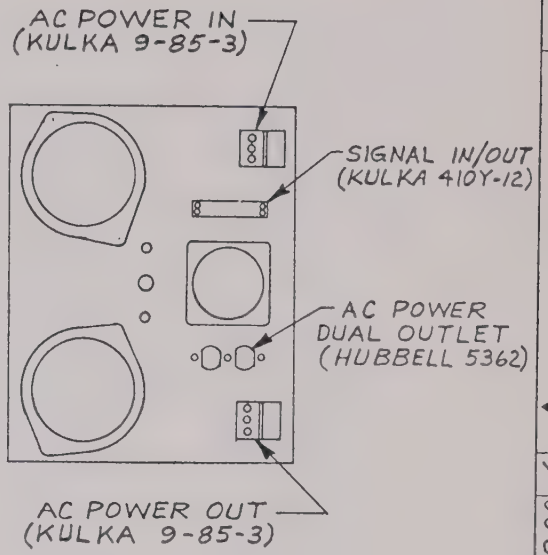


FRONT VIEW



TOP VIEW

PLUG-IN OSCILLATOR PURCHASE SEPARATE



C4100-900/

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

DIM IN INCHES TOLERANCES .XXX = .010 .XX = .03 X° = 30'

BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓

DWG SIZE C

TITLE: OUTLINE DRAWING 1000 VA AMPLIFIER

CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

MODEL 1001-T

CONTRACT NO. | CODE IDENT 16067

RELEASE				
CHECKER		1/16/70	PURCHASING	
DESIGN		1/5/70	PROJ ENGR	
DRFTSMN		1/5/70	CHF ENGR	

DWG NO. C4100-900 REV /

SCALE 1/4 SHT 1

DATE	NEXT ASSEMBLY	EFF ON	AUTH

1. FRONT PANEL DIMENSIONS PER W.E./E.I.A STD.

NOTES: (UNLESS OTHERWISE SPECIFIED)

GENERAL DESCRIPTION

1.1 INTRODUCTION

This instruction manual contains information on the installation, operation, calibration, and maintenance of the California Instruments Model 1201T Power Source. Detailed schematics, parts location drawings, calibration procedures, and theory of operation are also contained for the aid of maintenance personnel.

1.2 GENERAL DESCRIPTION

The California Instruments Model 1201T Power Amplifier is a solid state, high performance, low distortion power source that provides up to 1200 VA output when used with the proper oscillator. The Model 1201T Power Source is illustrated in Figure 1-1. Full power output is available in four different voltage ranges and over the frequency range from 45 Hz to 5 KHz. These full power voltage ranges are:

1) 27.5 to 30 volts rms for applications where four units are to be stacked to provide 4800 VA at 120 volts,

2) 55 to 60 volts rms for applications where two units are to be stacked to provide 2400 VA at 120 volts,

3) 110 to 120 volts rms for normal single phase 115 volt applications and for three phase 208 volt line-to-line applications,

4) 220 to 240 volts rms for normal single phase 230 volt applications.

For two phase and three phase operation, at least two power amplifiers must be combined together with the applicable multi-phase oscillator. Two power amplifiers will provide a total of 2400 VA two phase power, or 2400 VA of three phase power in the open delta configuration. Three power amplifiers will provide 3600 VA of three phase power in the wye configuration.

1.3 ACCESSORY EQUIPMENT

The following accessories are available for use with the California Instruments Model 1201T Power Source:

1.3.1 Zero Manufacturing Company Model CTN118 rack slides. These rack slides may be bolted directly to the sides of the unit, if required.

1.3.2 Model 4100-703 Extender Card. This card allows the pre-amplifier printed circuit board to be extended above the unit for service work.

1.3.3 Series 800T Variable Frequency Oscillators. These general purpose Wien Bridge Oscillators provide one phase, two phase or three phase outputs over the range from 20 Hz to 20 KHz in three bands. Units with single phase output are designated as 800T-20/20K-1-1ϕ, two phase oscillators are designated as 800T-20/20K-1-3ϕ. Calibration accuracy is ± 1% at 25°C and amplitude stability is .25% per 24 hours at 25°C. The total harmonic distortion is less than 0.25% from 20 Hz to 20 KHz.

1.3.4 Series 810T Fixed Frequency Oscillators. These oscillators provide one phase, two phase or three phase output over the range from 45 Hz to 10KHz. Units with single phase output are designated as 810T-Freq-.1-1ϕ, two phase oscillators are designated as 810T-Freq-.1-2ϕ, and three phase oscillators are designated as 810T-Freq-.1-3ϕ. Frequency accuracy is ± 0.1% at 25°C. Amplitude stability is ± 0.01% per 24 hours at 25°C and varies less than .0025% per degree centigrade. Harmonic distortion is less than 0.1% from 45Hz to 5KHz.

1.3.5 Series 815T Fixed Frequency Oscillators. These low-cost fixed frequency oscillators provide one phase, two phase or three phase outputs over the range from 45Hz to 10KHz. Units with single phase output are designated as 815T-Freq-.1-1ϕ, two phase oscillators are designated as 815T-Freq-.1-2ϕ, and three phase oscillators are designated as 815T-Freq-.1-3ϕ. Frequency accuracy is ±0.1% at 25°C. Amplitude stability is ± .25% per 24 hours at 25°C and varies less than 0.02% per degree centigrade. Harmonic distortion is less than 0.2% from 45Hz to 10 KHz.

1.3.6 Series 820T Fixed Frequency Crystal Oscillators. These Oscillators provide one phase, two phase or three phase outputs over the range from 45 Hz to 20 KHz. Units with single phase output are designated as 820T-Freq-Accuracy-1ϕ, two phase oscillators are designated as 820T-Freq-Accuracy-2ϕ, and three phase oscillators are designated as 820T-Freq-Accuracy-3ϕ. Frequency accuracy is ± 0.01% or ± 0.0001%. Amplitude stability is 0.25% per 24 hours at 25°C. The total harmonic distortion is less than 0.15% for versions from 45 Hz to 5 KHz.

1.3.7 Series 830T Programmable Oscillators. These oscillators provide one phase, two phase or three phase outputs over the range from 45 Hz to 9.99 Khz. These units are packaged in a separate 5-1/4 inch package which may be mounted above/below the associated power amplifier.

1.3.8 Series 840T Programmable Oscillators. These plug-in oscillators provide one phase, two phase or three phase outputs at 380, 400 and 420 Hz. Frequency accuracy is ± 0.1% of programmed value. Servo feedback is taken from the output of each phase back to the 840T Programmable plug-in oscillator and provides an accuracy of ± 0.1% of programmed value.

CAUTION

HIGH VOLTAGE (250 VAC)

Voltages up to 250 VAC are available in certain sections of this power source. This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with pin C and pin D of the plug in oscillator, the primary power circuits, and the output circuits of the power source.

INSTALLATION AND OPERATION

2.1 UNPACKING

The California Instruments Model 1201T Power Source is shipped in a cardboard container with protective inner packing. Do not destroy the packing container until the unit has been inspected for possible damage in shipment.

2.2 POWER REQUIREMENTS

2.2.1 The Model 1201T Power Source has been designed to operate from any one of the following AC line voltages: 115 volts, 208 volts, 220 volts, 230 volts or 240 volts rms. The power transformer is normally wired at the factory for operation from the 230 volt line. Table 2-1 below indicates how the primary connections to the power transformer are made for various AC input line voltages.

TABLE 2-1

NOTE

Prior to reconnecting power transformer T1, remove all existing jumpers from the primary windings.

Nominal Input Voltage	Operating Line Voltage Range	Power Transformer Connections	Front Panel Circuit Breaker Value
115 volts rms	105-125 volts rms	jumper pins 1 and 3; jumper pins 2 and 6; connect load side of circuit breaker to pin 6.	50 ampere
208 volts rms	190-226 volts rms	jumper pins 2 and 3; connect load side of circuit breaker to pin 4.	25 ampere
220 volts rms	201-239 volts rms	jumper pins 2 and 3; connect load side of circuit breaker to pin 5.	25 ampere
230 volts rms	210-250 volts rms	jumper pins 2 and 3; connect load side of circuit breaker to pin 6.	25 ampere
240 volts rms	219-261 volts rms	jumper pins 2 and 3; connect load side of circuit breaker to pin 7.	25 ampere

2.2.2 The Model 1201T has been designed to operate over the line frequency range from 48 to 65 Hz. On special order, units will be supplied to operate from the 400 Hz line.

2.2.3 The normal input power, at rated output, is between 2800 and 4200 watts depending on line and load conditions. During "turn-on" the peak transient will generally exceed 6000 watts.

2.3 CIRCUIT BREAKER REQUIREMENTS

The Model 1201T Power Source uses a 50 ampere Heinemann AM12-50A curve 5 circuit breaker for operation from the 115 volt AC line. A Heinemann AM12-25A curve 5 circuit breaker is used for operation from the 208 volt through 240 volt AC lines. Substitution of circuit breaker type or current rating may cause permanent damage to the unit.

2.4 OUTPUT VOLTAGE, METER RANGE, AND FRONT PANEL RANGE INDICATOR

2.4.1 The output voltage available from the Model 1201T Power Source is determined by a rear loaded printed circuit card. This card plugs into a connector located inside the power source and accessible by removing the small fan at the rear of the unit. Rotate the printed circuit card until the desired output voltage range has been found and then re-insert the printed circuit card into the connector and replace the fan.

2.4.2 This card is also used to select the proper range for the front panel voltmeter and to illuminate the proper front panel range indicator lamp.

2.5 ACCEPTANCE TEST PROCEDURE

Inspect the unit for any possible shipping damage immediately upon receipt. If damage is evident, notify the carrier. DO NOT return an instrument to the factory without prior approval. If the unit appears in good condition, perform the following.

2.5.1 Connect the AC line input to an AC power line of the proper voltage and frequency as determined by either the serial number tag on the unit or by inspection of the wiring to the primary of the power transformer (see Section 2.2 of this instruction manual). Use number 8 wire to connect the AC power line to the AC input terminals at the rear of the unit if the unit is being operated from the 115 volt AC line; use number 10 wire if the unit is being operated from the 208 volt through 240 volt AC power line. Connect a 5 KW Variac and a 5 KW wattmeter in series with the AC line. Turn the variac up to the required line voltage and then apply AC line power to the power source. The Model 1201T Power Source should draw less than 400 watts under no load conditions at mid-line voltage. If a problem is encountered, perform step 4.3.2 of the CALIBRATION PROCEDURE.

2.5.2 Using either a California Instruments 800T Series Oscillator or a suitable external low distortion sine wave oscillator, set the oscillator to the desired frequency (between 45 Hz and 5 KHz) and adjust the output of the oscillator to 5 volts rms. The amplifier input is available at Pin 2 (tie oscillator ground to Pin 1) of the small terminal strip TB1 located on the rear of the unit, if the external oscillator is employed. Tie a jumper strap from Pin 2 to Pin 3 of TB1 if an 800T Series Plug-in Oscillator is being used as the signal source.

2.5.3 Select the proper output voltage range according to the procedure given in Section 2.4 of this instruction manual. The following table lists the proper external load for full power output on each of the voltage ranges.

Output Voltage Range	Output Voltage	Full Power Load Resistance	50 Percent Power Load Resistance
0-30 volts rms	30 volts rms	0.75 ohms	1.5 ohms
0-60 volts rms	60 volts rms	3.0 ohms	6.0 ohms
0-120 volts rms	120 volts rms	12.0 ohms	24.0 ohms
0-240 volts rms	240 volts rms	48 ohms	96 ohms

2.5.4 Connect the proper 1200 watt load resistor to the large output terminals at the rear of the power source which are labeled "AC POWER OUTPUT HIGH-LOW." Connect a Tektronix Model 533A Oscilloscope or equivalent across this load resistor.

2.5.5 Using the GAIN control and the proper range on the front panel METER, set the output voltage to the rated voltage of the unit as determined in Section 2.5.3 of this manual. The power line wattmeter should read 3100 to 3700 watts at midline. Check on the oscilloscope for peak clipping or excessive distortion of the sine wave output.

2.5.6 With the output still adjusted as determined in 2.5.5, place a resistor in parallel with the external load resistor to provide a 50% overload on the output of the power source. The value of this resistor is given in Section 2.5.3 of this manual. The signal on the oscilloscope should exhibit significant clipping on both the positive and negative peaks.

2.5.7 Remove the 50 per cent overload resistor and the output should automatically return to normal.

2.5.8 Place a short circuit in parallel with the external load resistor and then remove the short circuit after a few seconds. The signal on the oscilloscope should go to zero and then return to normal when the short circuit is removed. The front panel circuit breaker may be activated if the short circuit remains across the output for a long period of time.

2.5.9 The CALIBRATION PROCEDURE given in Section 4.0 of this manual should be followed if a more detailed evaluation of the unit is required at this time.

2.6 MECHANICAL INSTALLATION

The Model 1201T Power Source has been designed for rack mounting in a standard 19 inch rack. The unit should be supported from the bottom with a shelf-track or supported from the sides with a pair of rack slides (Zero Manufacturing type CTN-118 or equivalent.)

The cooling fans on the rear of the unit must be free of any obstructions which would interfere with the flow of air. A 2.5 inch clearance should be maintained between the rear of the fans and the rear door of the mounting cabinet. Also the air intake holes on the sides and rear of the power source must not be obstructed.

2.7 INPUT POWER WIRING

The Model 1201T Power Source will operate from single phase input voltages from 105 volts to 260 volts rms in five ranges as described in Section 2.2 of this manual. The power source should be used with 115 volt power lines with a capacity of 50 amperes or greater. If 200 to 260 volt AC lines are used, their capacity should be 25 amperes or greater.

2.8 OUTPUT POWER WIRING

The power output wires should be large enough to avoid excessive line voltage drops. The front panel regulation control is capable of providing greater than 2 per cent over regulation for all normal load conditions. If it is desired to provide a zero output impedance at the load side of the power wiring, it is necessary that these line drops be limited to approximately 1 to 2 per cent of the required output voltage. The following table lists the minimum acceptable wire size for a 1.0 per cent line drop assuming a 1200 VA output at a distance of 20 feet from the power source to the load.

Output Voltage	Maximum Line Drop	Load Current	Loop Length	Minimum Required Wire Size
30 volts	0.3 volts	40 amperes	40 feet	#3
60 volts	0.6 volts	20 amperes	40 feet	#9
120 volts	1.2 volts	10 amperes	40 feet	#15
240 volts	2.4 volts	5.0 amperes	40 feet	#21

The wire size should be reduced 3 sizes every time that the distance between the power source and load is doubled.

2.9 FRONT PANEL CONTROLS

2.9.1 The circuit breaker, located on the front panel of the Model 1201T Power Source, is used to switch the POWER to the unit "ON." At this time the amber indicator lamp located above this circuit breaker should glow.

2.9.2 The GAIN control is used to adjust the output voltage level of the power source. In the case of a multi-phase power source, the gain control is turned nearly fully clockwise and then used as a fine gain trim control. The amplitude of the output of the multi-phase system is controlled by the amplitude control located on the multi-phase oscillator.

2.9.3 The REG control is recessed behind the front panel and is screw driver adjustable. This control is used to vary the output impedance of the power source. Turning this control in the clockwise direction reduces the output impedance of the power source. If this control is rotated far enough in the clockwise direction, the power source will exhibit a negative output impedance and may be used to compensate for line voltage drops between the output of the power source and the load. Section 2.8 includes additional information on the possible application of this control.

2.9.4 The RANGE lamps on the front panel indicate which output voltage range, 0 to 30 volts, 0 to 60 volts, 0 to 120 volts or 0 to 240 volts is activated by the rear loaded printed circuit card. The corresponding voltmeter ranges are 0 to 40 volts, 0 to 80 volts, 0 to 160 volts and 0 to 320 volts, full scale, respectively.

2.9.5 The OVERLOAD lamp on the front panel indicates if the power source is being loaded excessively. This lamp may be activated momentarily during start-up of a non-linear load such as an AC motor load or an incandescent lamp load.

2.9.6 The front panel circuit breaker will be activated if the power source is loaded with an excessive amount of shunt capacitive load. If shunt capacitors are used to correct the power factor of an inductive load, connect a small amount of resistance in series with the shunt capacitor. The value of this resistor should be equal to approximately 10% of the reactance of the shunt capacitor at the operating frequency of the system.

2.10 OPERATION OVER EXTENDED FREQUENCY RANGE

2.10.1 This power source must not be driven at signal frequencies below 20 Hz or above 20 KHz, otherwise permanent damage to the unit may occur. For operation in the region between 20 Hz and 45 Hz and for operation in the region between 5 KHz and 20 KHz, derate the output voltage and output power according to Table 2 - 2. in order to provide reliable operation of the power source.

TABLE 2 - 2

Output Frequency	Maximum Safe Output Voltage				Maximum VA Output at Maximum Safe Output Voltage with ± 0.7 Power Factor Load.
	30 Volt Range	60 Volt Range	120 Volt Range	240 Volt Range	
20Hz	13.3V	26.6V	53.2V	107V	500 VA
30Hz	20V	40V	80V	160V	800 VA
40Hz	26.7V	53.5V	107V	214V	1150 VA
45Hz to 5KHz	30V	60V	120V	240V	1200 VA
5KHz to 10KHz	30V	60V	120V	240V	600 VA
15KHz	20V	40V	80V	160V	265 VA
20KHz	15V	30V	60V	120V	144 VA

THEORY OF OPERATION

3.1 GENERAL

The California Instruments Model 1201T Power Source is an all silicon solid state 1200 VA amplifier and, with companion oscillator, is designed to provide reliable sine wave AC Power over the frequency range from 45 Hz to 5 KHz.

A block diagram for the amplifier is shown in Figure 3-1. The pre-amplifier A1G1 is used to amplify the input signal to such a level so as to supply adequate drive to the power amplifier A1G2.

The power amplifier A1G2 provides the necessary sine wave signal to drive the output transformer T2. The output transformer has floating secondary windings which allow the load to float from the amplifier and oscillator circuitry.

The power amplifier A1G2 contains the overload and short circuit protection circuitry. A local negative feedback loop is taken from the output of the power amplifier back to the pre-amplifier, A1G1.

The overall negative feedback is taken from the feedback winding of the output transformer back to one input of the pre-amplifier via resistor A1R7. This feedback provides a closed loop gain of 20 from the high side of A1R5 to the primary of T2.

The positive feedback signal is generated by sensing the IR drop across the primary of T2 and applying this signal to transformer A1T1. Transformer A1T1 converts this differential signal into a single-ended signal and applies it to the input of the pre-amplifier through a divider network containing the regulation control R2. As this positive feedback is increased from zero with potentiometer R2, the output impedance of the power source is reduced toward zero.

The multiple secondary of transformer T2 is inner connected by means of a rear loaded printed circuit board, assembly A9. The rotation of this board is used to determine the output voltage range of the power source. This board also controls the front panel range lights and the range of the front panel voltmeter.

Power transformer T1, along with the associated rectifiers and filters, supply the operating voltages for the plug-in oscillator, the pre-amplifier A1G1, and the output amplifier A1G2.

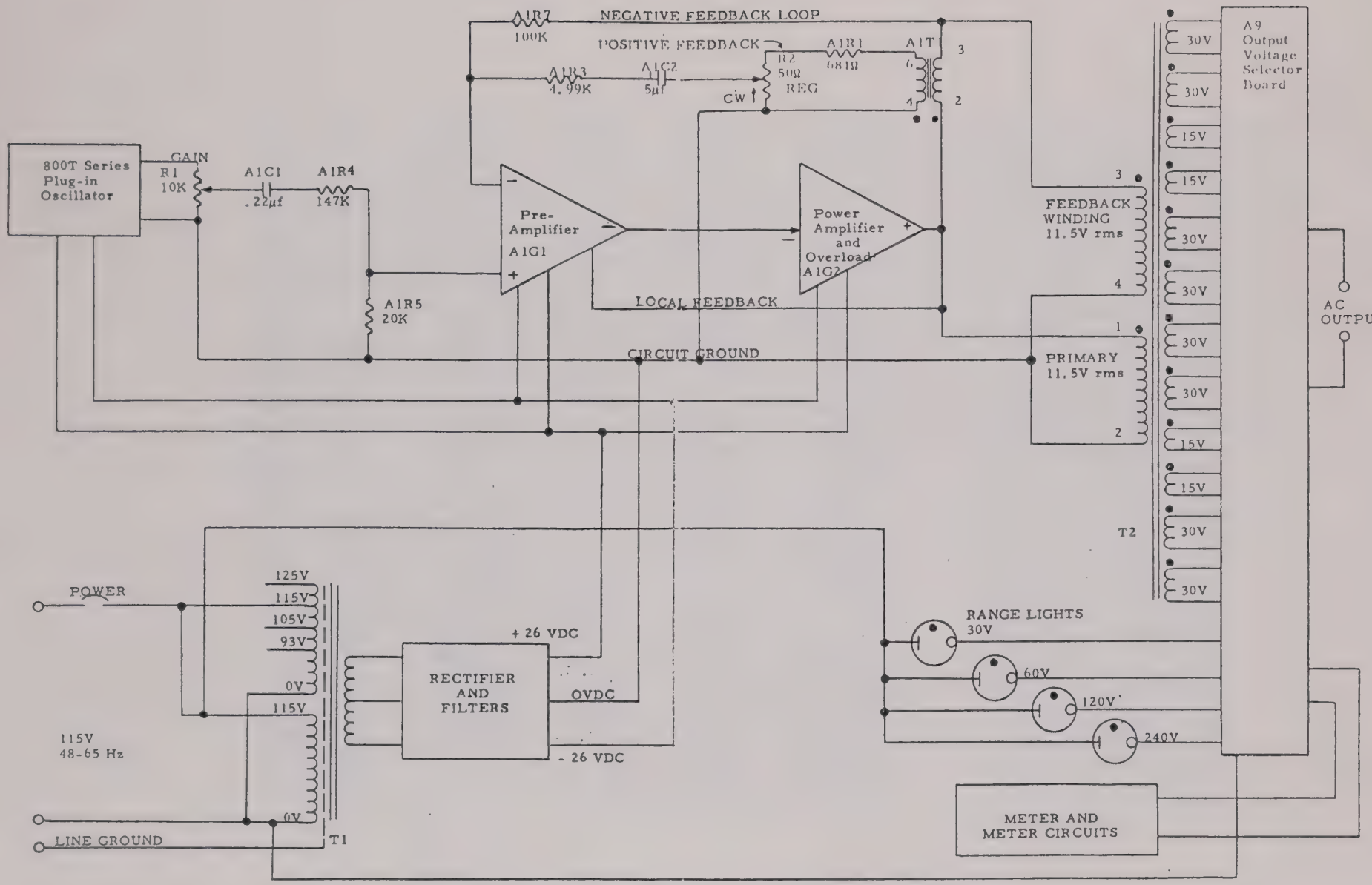


FIGURE 3-1. BLOCK DIAGRAM FOR MODEL 1201T POWER SOURCE

3.2 DETAILED CIRCUIT DESCRIPTION

A schematic diagram for the Model 1201T Power Source is shown in drawing E4120-070, with the exception that the circuitry contained on the pre-amplifier circuit board (assembly A1), the meter board (assembly A6), the output voltage range selector board (assembly A9), and the plug-in oscillator. A schematic for the pre-amplifier circuit board is given in drawing D4100-071 and a schematic for the meter circuit is given in drawing B4050-072. A schematic for the range selector board is given in drawing D4120-071. For information on the plug-in oscillator, consult the applicable oscillator manual. These drawings give typical voltage levels and waveforms for the various sections of the power source.

3.2.1 PRE-AMPLIFIER

The pre-amplifier A1G1 is a part of the A1 assembly and consists of transistors A1Q1 through A1Q6 and associated components connected as a direct coupled differential amplifier. The open loop gain of this pre-amplifier is approximately 30 at 400 Hz and rolls off at 6 db per octave from 10 to 30 KHz.

Transistor A1Q1 is a dual field effect transistor used in the differential source follower configuration to provide a high input impedance and a gain of approximately 1.0. Potentiometer A1R11 is used to adjust the DC bias at the primary of T2 to zero volts with no signal.

Transistor A1Q2 is a dual transistor used in a differential configuration and provides a gain of approximately 15 at 400 Hz. Capacitor A1C6 and resistor A1R20 provide a high frequency step roll off from 10 KHz to 30 KHz.

Transistor A1Q3 and associated components are connected as a constant current source which provides the emitter current for A1Q2. This current source is designed to sink 2 milliamperes from the junction of A1R14 and A1R15 to the -10 volt supply.

Transistors A1Q4, A1Q5 are used in the differential amplifier configuration and provide an open loop gain of 2 at 400 Hz.

Transistor A1Q6 and associated components are connected as a constant current source which provides 8 milliamperes to the junction of A1R19 and A1R21.

3.2.2 POWER AMPLIFIER

The power amplifier A1G2 mechanically consists of the remainder of the A1 board and the large heatsinks designated as the A2 through A5 assemblies. Electrically, the power amplifier consists of transistors A2Q1 through A2Q10, A3Q1 through A3Q10, A4Q1 through A4Q10, A5Q1 through A5Q10, A1Q7 through A1Q12 and associated components.

Transistor A1Q7 and associated components are connected as a constant current source which provides 30 milliamperes to bias the output stage by means of diodes A1CR8, A1CR9, A1CR10 and A1R58. This allows the output stage to operate as a Class A amplifier for no load or low VA load conditions and to operate nearly as a Class B amplifier for large load conditions.

Transistor A1Q9 and associated components are connected in the grounded emitter configuration. Local negative feedback is provided by A1C9, A1C11, A1C12, A1R41 and A1R42. The local feedbacks limits the gain of this stage to 15 at 400 Hz. The gain falls off at 6 db per octave from 10 KHz to 100 KHz.

The positive polarity output amplifier is contained on the A2 and A3 assemblies and consists of A2Q1 through A2Q10 and A3Q1 through A3Q10 connected as emitter followers. These transistors supply a total of 175 amperes peak during the positive one-half cycle of the output wave form when the power source is loaded to 1200 VA output at 91.6 per cent of rated output voltage (worst case condition within specification limits). These positive output amplifier transistors and their associated heatsinks can dissipate over 1200 watts with less than a 40°C case temperature rise with an air flow of 100 cfm per heatsink.

The negative polarity output amplifier is contained on the A4 and A5 assemblies and consists of A4Q1 through A4Q10 and A5Q1 through A5Q10 connected in the quasi complementary symmetry configuration. These transistors supply a total of 175 amperes peak during the negative one-half cycle of the output waveform when the power source is loaded to 1200 VA output at 91.6 per cent of rated output voltage (worst case condition within specification limits). These negative output amplifier transistors and their associated heatsinks can dissipate over 1200 watts with less than a 40°C case temperature rise with an air flow of 100 cfm per heatsink.

When the power source is delivering its full rated output voltage, the primary of the output transformer has an 11.5 volt rms signal.

3.2.3 OVERLOAD PROTECTION

The overload protection circuitry is shown in drawing D4100-071 and consists of A1Q11, A1Q12 and associated components.

Transistor A1Q12 and associated components are connected as a clamp circuit which is used to protect the positive polarity output amplifier (assemblies A2 and A3) during periods of overload or short circuit. This is accomplished by sensing the load current flowing through A2R3 and applying the resultant voltage drop to the emitter-base junction of A1Q12 through a suitable attenuator network. During periods of overload, the emitter-base junction of A1Q12 is forward biased sufficiently to allow the collector circuit of A1Q12 to conduct a significant portion of the base drive normally available to A2Q1. This limits the base drive to A2Q1 and hence limits the available current from the positive polarity output amplifier during periods of overload. Potentiometer A1R54 is used to set the current level where the overload protection circuit is activated.

Transistor A1Q11 and associated components are used in a similar fashion to protect the negative polarity output amplifier (assemblies A4 and A5). The only differences are that the control voltage for A1Q11 is sensed across A4R11 and potentiometer A1R57 is used to set the overload current level.

The rated VA output of the power source is, to a large extent, determined by the power dissipation in the quasi complementary symmetry output stage. This power dissipation is determined by the power factor of the load, the output VA level of the amplifier, and to the actual output voltage expressed as a percentage of the rated output voltage. The derating chart, given in the specifications, expresses this derating in a graphical form.

The design of the overload circuitry is such that the overload level is determined by the same three parameters that determine the power dissipation in the push-pull output stage. Resistors A1R48, A1R49, A1R51, A1R52, A1R55 and A1R56 have been selected so that the overload protection circuit and the power factor derating chart track one another quite closely in the region between 0 volts output and 91.6 per cent of rated output voltage. In the region between 91.6 per cent of rated output voltage and 100 per cent of rated output voltage, the rated VA output of the power source is limited by an arbitrary rating and as a result, the overload circuit allows a somewhat greater power output than that specified for the power source. The unit will be reliable in this mode of operation; however, output distortion and/or other specifications may be excessive.

3.2.4 OVERLOAD INDICATOR LAMP

The front panel indicator lamp is activated by transistor A1Q10 and associated components. The emitter-base junction of A1Q10 is driven from the voltage developed across A2R3 through a suitable attenuator network. Potentiometer A1R53 is adjusted at the factory so that the overload lamp DS1 is activated at the same time that the overload protection transistors A1Q11 and A1Q12 are activated.

3.2.5 INITIAL START UP PROTECTION

Triac A1Q8, capacitor A1C8, and associated components are connected as an electronic switch which is used to protect the positive polarity power amplifier (assembly A2 and A3) during initial application of AC power to the input of the Model 1201T Power Source. As capacitor A1C8 is charged to +25 volts from the +25 volt power supply, the gate of A1Q8 is biased "ON." This, in turn, causes the maximum value of the voltage at the base of A2Q1 to be clamped to approximately +1.0 volt. This, in turn, limits the output current of the positive polarity amplifier (assemblies A2 and A3) to a negligible value during start-up conditions. As transistor A1Q9 begins to conduct, the load current through the triac A1Q8 drops below the minimum value of "holding current" and A1Q8 is switched off.

3.2.6 OVERALL NEGATIVE FEEDBACK

The overall negative feedback loop is a single-ended potentiometric feedback loop taken from the negative feedback winding of T2 back to the gate of A1Q1B. The feedback network consists of R2, A1R3, A1R7 and A1C2 and limits the mid-band closed loop voltage gain of the amplifier to 20 from the gate of A1Q1A to the primary T2.

This overall feedback loop provides approximately 20 dB of negative feedback over the range from 45 Hz to 10 Khz. The feedback rolls off at approximately 9 dB per octave for frequencies greater than 10 KHz. The purpose of this feedback loop is to insure that the frequency response, distortion, gain and amplitude stability specifications are met and/or exceeded.

A low frequency negative feedback loop is taken from the power primary winding of T2 back to the gate of A1Q1B through A1R8 and A1R9. This loop limits the closed loop voltage gain of the amplifier to 1.5 at DC and thereby provides improved DC bias stability for the amplifier.

3.2.7 POSITIVE CURRENT FEEDBACK

The positive current feedback loop generates a positive feedback voltage proportional to the load current in the secondary of T2. This is accomplished in the following fashion:

The load current in the secondary of the output transformer T2 is reflected back into the power primary winding producing an IR drop across the power primary winding. The negative feedback winding is connected so as to buck out the $L\frac{di}{dt}$ drop in the power primary winding. The remaining differential signal is applied to the primary of transformer A1T1 and converted into a single-ended signal at the secondary of A1T1. This signal is then applied to the gate of A1Q1B through a divider network consisting of A1R1, A1R2, A1R3, R2, A1C2 and A1C3. Potentiometer R2, which is accessible from the front panel of the unit, is used to adjust the amount of positive feedback and thereby adjust the output impedance of the power source.

3.2.8 POWER SUPPLY

A schematic diagram for the DC power supply is part of drawing E4120-070. This power supply delivers ± 26.0 volts ± 5 per cent at 51 amperes DC with less than 3 volts peak-to-peak ripple from the 115 volt, 60 Hz AC line. These unregulated supplies consist of rectifier diodes A7CR1 through A7CR4 and filter capacitors A8C1 through A8C8 connected in a conventional fashion.

3.2.9 FRONT PANEL METER

The front panel meter M1 has a full scale sensitivity of 0 to 1 milliampere DC and an internal resistance of approximately 100 ohms. The meter has four scales with full scale ranges of 0 to 40 volts AC, 0 to 80 volts AC, 0 to 160 volts AC and 0 to 320 volts AC. The meter rectifiers and scaling circuitry are mounted on the rear of the meter.

The meter circuitry is designated as the A6 assembly and is shown in drawing B4050-072. This circuitry consists of rectifier diodes A6CR1 through A6CR4, potentiometer A6R1 and associated components. The four rectifier diodes are connected so as to form a full wave bridge rectifier. Potentiometer A6R1 is used to shunt a small portion of the meter current and provide a sensitivity adjustment on the 40 volt scale. Resistors A6R3, A6R4 and A6R5 are set at the factory to provide proper tracking on the 320 volt, 160 volt and 80 volt ranges, respectively.

The meter range is automatically switched as the rotation of the rear loaded voltage range board is changed. The 40 volt full scale range of the meter is used with the 0-30 volt range of the power source, the 80 volt full scale range of the meter is used with the 0 to 60 volt range of the power source, the 160 volt full scale range of the meter is used with the 0 to 120 volt range of the power source, and the 320 volt full scale range of the meter is used with the 0 to 240 volt range of the power source.

3.2.10 OUTPUT VOLTAGE RANGE

The output voltage range is controlled by the rotation of printed circuit board A9. A schematic for this printed circuit board is shown in drawing D4120-071. The primary purpose of this printed circuit board is to interconnect the multiple secondary windings of T2 in various fashions depending on the desired output voltage range. Table 3-1 on the following page illustrates this interconnection.

TABLE 3-1

OUTPUT VOLTAGE RANGE	INTERCONNECTION
0 to 30 volts rms	S3 and S4 are connected in the series aiding configuration; S9 and S10 are connected in the series aiding configuration; each of these two sets of windings are then connected in parallel with S1, S2, S5, S6, S7, S8, S11 and S12 to provide the 0 to 30 volt output.
0 to 60 volts rms	S2 is in parallel with S1; S6 is in parallel with S5; S8 is in parallel with S7; and S12 is in parallel with S11. S3, S4, S9 and S10 are connected in the series aiding configurations; S1 and S5 are connected in the series aiding configuration; S7 and S11 are connected in the series aiding configuration. These three configurations are in parallel to provide the 0 to 60 volt output.
0 to 120 volts rms	S2 is in parallel with S1; S6 is in parallel with S5; S8 is in parallel with S7; S12 is in parallel with S11: S3, S4, S9 and S10 are not used. S1, S5, S7 and S11 are connected in the series aiding configuration to provide the 0 to 120 volt output.
0 to 240 volts rms	S3, S4, S9 and S10 are not used. S1, S2, S5, S6, S7, S8, S11 and S12 are connected in the series aiding configuration to provide the 0 to 240 volt output.

CALIBRATION PROCEDURE

4.1 GENERAL

The following calibration procedure, or any part of it, may be performed on a routine basis to insure that the Model 1201T Power Source remains within specified tolerances. This procedure should always be performed after any repairs have been made to the unit. This procedure also covers test methods for the following power source adjustments and specifications:

a) Initial Adjustments

b) AC Line Input Power and Overload Adjustment

c) Voltage, Power Output and Harmonic Distortion

d) Line Regulation

e) Load Regulation Adjustment

f) Amplitude Stability

g) Frequency Response

h) AC Noise Level

i) 0.7 Lagging Power Factor

j) 0.7 Leading Power Factor

This calibration procedure assumes that the power source will be operated from the 230 volt 47 to 65 Hz AC line. For operation from the 115 volt AC line, a 120 volt variac and a 120 volt wattmeter must be substituted for those called out in this procedure. Consult Section 2.2.1 of this instruction manual for operation from other than the 230 volt AC line.

This calibration procedure further assumes that the power source is tested on the 0 to 120 volt range. Performance is very similar on the other three ranges. The following table illustrates the change in measurement voltage and impedance level when evaluating the power source on various output voltage ranges.

TABLE 4-1				
Rated Output Voltage	30V AC	60V AC	120V AC	240V AC
91.6% of Rated Output Voltage	27.5V AC	55.0V AC	110V AC	220V AC
Resistance Load for 1200 VA Output at Rated Output Voltage	0.75Ω	3.00Ω	12.0Ω	48.0Ω
Resistance Load for 1200 VA Output at 91.6% of Rated Output Voltage	0.63Ω	2.52Ω	10.1Ω	40.4Ω

Section 2.4 of this instruction manual indicates the procedure required to change output voltage ranges and Section 2.8 indicates some potential problems associated with output wiring IR drop on the low voltage ranges. When checking load regulation and amplitude stability, care should be taken to use a four-wire connection such that the external load and the measurement equipment have completely separate wiring from the large AC output terminal strip located at the rear of the power source.

4.2 TEST EQUIPMENT REQUIRED

The following test equipment is required to perform the calibration procedure assuming that the input voltage has a nominal value of 230 volts rms and that the power source is tested on the 0 to 120 volt AC range. Some equipment substitutions will be required if this is not the case.

a) Oscilloscope, Tektronix 533A with "W" plug-in.

b) 10.0 KVA Variac, General Radio 2XW50M or equivalent.

c) 5.0 KVA Wattmeter, Simpson Electric or equivalent.

d) Distortion Analyser, H. P. 330B or equivalent.

e) Differential Voltmeter, Fluke 883A or equivalent.

f) Multi-range 1200 watt load box, or individual 1200 watt power resistors, as defined in Table 4-1. Dale type NHL resistors or equivalent.

g) Expanded Scale (about 115 VAC) strip chart recorder, Voltron Model 89.038 or equivalent.

h) Multimeter, Simpson 260 or equivalent.

4.3 INITIAL ADJUSTMENTS

4.3.1 Connect the Model 1201T Power Source as shown in Figure 4-1. Turn the GAIN control fully counter-clockwise. Adjust the line voltage to its nominal value with the variac. Turn the POWER switch "on." The wattmeter should indicate 400 watts or less at nominal line voltage. If a problem is encountered, perform step 4.3.2 below.

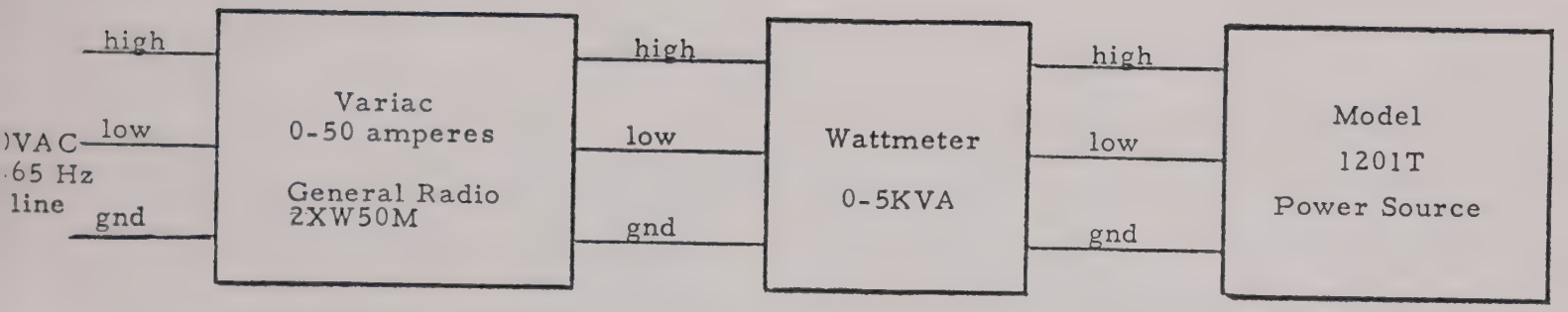
4.3.2 Turn the unit on its side and remove the bottom cover. Connect the differential voltmeter between terminal 1 and terminal 2 of T2. Adjust potentiometer A1R11 so that the DC voltage across the primary of T2 is 0.00 volts ±5 millivolts. This balances and minimizes the collector current in both halves of the output stage. If the input power is still excessive, reduce the size of resistor A1R58 somewhat.

4.3.3 Connect the differential voltmeter to the power output terminals at the rear of the unit and select the 0 to 30 volt range with the rear loaded printed circuit board. Adjust the GAIN control for a 30 volt output with the oscillator set to 400 Hz. Adjust the meter calibration control A6R1 so that the front panel meter and the differential voltmeter correlate within one per cent of each other. Vary the frequency from 45 Hz to 5 KHz and check that the front panel meter reads within ±3 per cent of the correct value.

4.3.4 Remove power from the unit and select the 0 to 60 volt range with the rear loaded printed circuit board. Set the oscillator to 400 Hz and adjust the output to exactly 60 volts while reading the differential voltmeter. Select resistor A6R5 so that the front panel meter and the differential voltmeter correlate within one per cent. Vary the frequency from 45 Hz to 5 KHz and check that the front panel meter reads within ±3 per cent of the correct value.

4.3.5 Remove power from the unit and select the 0 to 120 volt range with the rear loaded printed circuit board. Set the oscillator to 400 Hz and adjust the output to exactly 120 volts while reading the differential voltmeter. Select resistor A6R4 so that the front panel meter and the differential voltmeter correlate within one per cent. Vary the frequency from 45 Hz to 5 KHz and check that the front panel meter reads within ±3 per cent of the correct value.

4.3.6 Remove power from the unit and select the 0 to 240 volt range with the rear loaded printed circuit board. Set the oscillator to 400 Hz and adjust the output to exactly 240 volts while reading the differential voltmeter. Select resistor A6R3 so that the front panel meter and the differential voltmeter correlate within one per cent. Vary the frequency from 45 Hz to 5 KHz and check that the front panel meter reads within ±3 per cent of the correct value.



See Table 2-1 for AC line input wiring to the Model 1201T Power Source. Unit is normally wired for 230 ± 20 volts AC line operation.

FIGURE 4-1. Test set up for initial adjustment of Model 1201T Power Source.

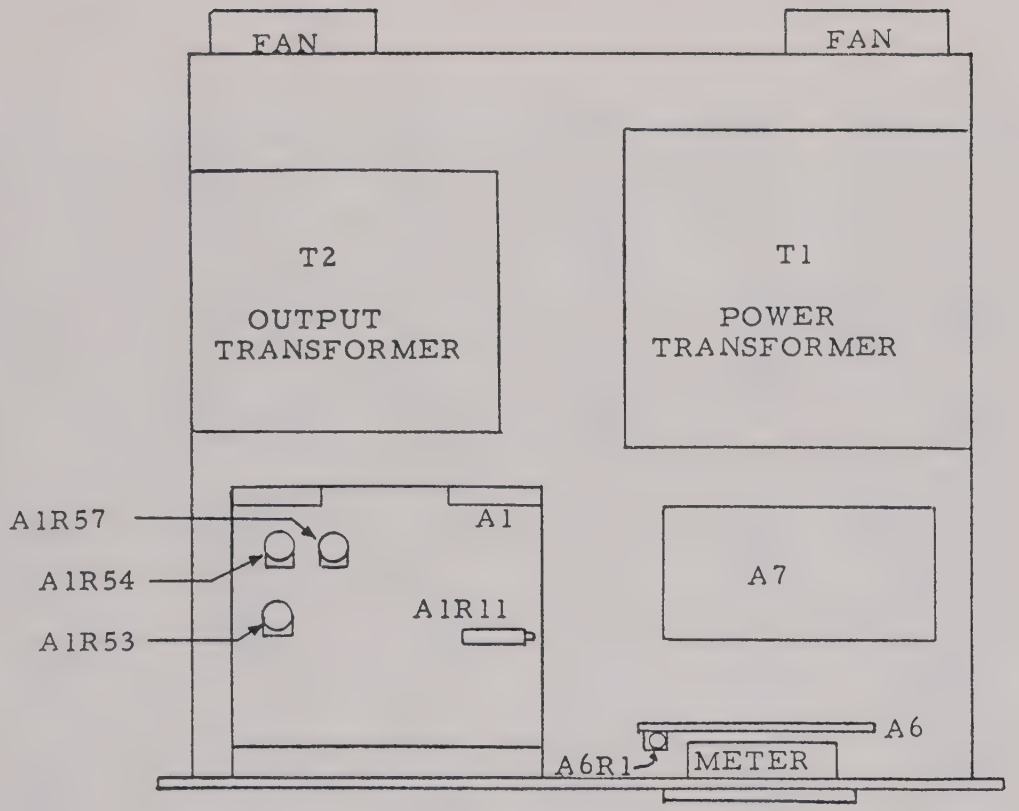


FIGURE 4-2. Internal Adjustments for Model 1201T Power Source.

4.4 AC LINE INPUT POWER AND OVERLOAD ADJUSTMENT

4.4.1 Connect the Model 1201T Power Source as shown in Figure 4-3. Select the 120 volt range and adjust the output voltage of the power source to 110 volts rms (91.6 per cent of rated output voltage) at 400 Hz. Close switch S2 (10.1 ohm load) and readjust the output voltage slightly, if required, in order to maintain a 110 volt output. The power source should deliver a clean sine wave output with less than 0.30 per cent distortion. Vary the frequency from 45 Hz to 5KHz and check that the distortion does not exceed 0.5 per cent at 5 KHz over the AC input line voltage range of 210 to 250 volts while maintaining the output voltage at 110 volts rms. Adjust potentiometer A1R54 so that no clipping or excessive distortion occurs on the positive peak of the output wave form under worst case conditions outlined above. Adjust potentiometer A1R57 so that no clipping or excessive distortion occurs on the negative peak of the output wave form under worst case conditions outlined above. These two adjustments may interact somewhat, so care should be taken not to move one adjustmentsexcessively without checking the effect on the other adjustment.

4.4.2 With the AC input line voltage adjusted to its maximum value (normally 250 volts AC), close switch S2 and set the output voltage to 110 volts rms at 400 Hz. The AC line wattmeter should indicate less than 4200 watts.

4.4.3 Repeat step 4.4.2 except close switch S1 instead of S2 and set the output voltage to 120 volts rms (100 per cent of rated output voltage). Maintain the input AC line voltage at 250 volts rms. The AC line wattmeter should indicate less than 3900 watts.

4.4.4 Repeat step 4.4.2 except open switch S1 (no load on output of power source). The AC line wattmeter should indicate less than 500 watts with a line voltage of 250 volts rms.

4.4.5 This procedure may be performed for any of the other output voltage ranges, rather than the 0 to 120 volt range, if desired. In this case, the rear loaded printed circuit board should be rotated to provide the proper output voltage range. The load impedance and output voltage levels should be taken from those given in Table 4-1.

4.5 VOLTAGE, POWER OUTPUT AND HARMONIC DISTORTION

4.5.1 Connect the Model 1201T Power Source as shown in Figure 4-3. Select the 120 volt range with the rear loaded printed circuit board. Adjust the variac to provide a 230 volt AC line input and allow the power source to warm up for a few minutes. Set the oscillator output to 400 Hz and adjust the output of the amplifier with the GAIN control to provide 120 volts rms (100% of

rated output). Close switch S1 so that the 12.0 ohm load is across the output of the power source.

4.5.2 Vary the AC line voltage from 210 to 250 volts with the variac and check that no significant clipping is observed on the sine wave output with the oscilloscope. The harmonic distortion must be less than 0.3 per cent over the full line voltage range.

4.5.3 Set the oscillator output to 45 Hz and adjust the output of the power source to 120 volts rms with the GAIN control. Repeat step 4.5.2. The harmonic distortion must be less than 0.50 per cent over the full line voltage range.

4.5.4 Set the oscillator output to 600 Hz and adjust the output of the power source to 120 volts rms with the GAIN control. Repeat step 4.5.2. The harmonic distortion must be less than 0.30 per cent over the full line voltage range.

4.5.5 Set the oscillator output to 5 KHz and adjust the output of the power source to 120 volts rms with the GAIN control. Repeat step 4.5.2. The harmonic distortion must be less than 0.50 per cent over the full line voltage range.

4.5.6 Repeat steps 4.5.1 through 4.5.4 except set the output of the power source to 110 volts rms (91.6 per cent of rated output) and close switch S2 instead of S1. The harmonic distortion must be less than 0.3 per cent from 200 Hz to 600 Hz, and less than 0.50 per cent from 45 Hz to 5 KHz.

4.5.7 This procedure may be performed for any of the other output voltage ranges, rather than the 0 to 120 volt range, if desired. In this case, the rear loaded printed circuit board should be rotated to provide the proper output voltage range. The load impedance and output voltage levels should be taken from those given in Table 4-1.

4.6 LINE REGULATION

4.6.1 Connect the Model 1201T Power Source as shown in Figure 4-3. Select the 120 volt range with the rear loaded printed circuit board. Set the oscillator frequency to 400 Hz. Close switch S1 (12.0 ohm load) and adjust the output of the power amplifier to 120 volts rms (100% of rated output voltage) at 400 Hz.

4.6.2 Vary the line voltage from 210 volts to 250 volts AC and measure the change in output voltage of the power amplifier. This change should be less than 0.60 volts rms.

4.6.3 Set the frequency of the oscillator to 5 KHz and repeat 4.6.1 and 4.6.2. The change in the output voltage should be less than 0.60 volts rms.

NOTE

Care should be taken to insure that the output amplitude of the oscillator remains stable and independent of line conditions during this test.

4.6.4 This procedure may be performed for any of the other output voltage ranges, rather than the 0 to 120 volt range, if desired. In this case, the rear loaded printed circuit board should be rotated to provide the proper output voltage range. The load impedance and output voltage level should be taken from those given in Table 4-1.

4.7 LOAD REGULATION ADJUSTMENT

The load regulation adjustment is accessible from the front panel of the power source and is usually adjusted for zero regulation at 400 Hz. This adjustment is somewhat sensitive to the output voltage range and should be readjusted whenever the output voltage range is changed.

4.7.1 Connect the Model 1201T Power Source as shown in Figure 4-1. Check that the load is connected to the large AC output terminals at the rear of the power source. The output voltage may be monitored either at the rear or the front of the power source. If it is monitored at the rear of the power source, care should be taken to use four-wire sensing. Adjust the output voltage of the Model 1201T Power Source to 110 rms output (91.6 per cent of rated output voltage) at 400 Hz.

4.7.2 Place the differential voltmeter on the 1000 volt AC range and connect it across the front panel output terminals of the power source. Adjust R2 (accessible from the front panel of the power source and labeled REG) so that the output voltage variation is less than 20 millivolts as the 10.1 ohm load is added and removed. Maintain the line voltage at 115 volts during this test.

4.7.3 Set the frequency of the oscillator to 5 KHz. Adjust the output amplitude of the power source to 110 volts rms with no load on the output of the power source. The output of the power source should change less than ±1.10 volts when loaded with the 10.1 ohm resistor. Maintain the line voltage at 115 volts during this test. Capacitors A1C3 and A1R2, in the secondary circuit of A1T1, have been set at the factory for optimum load regulation in the 2 to 5 KHz region and may be changed if required.

4.7.4 Set the frequency of the oscillator to 45 Hz and repeat 4.7.3. The output of the power source should change less than ±1.10V.

4.7.5 This procedure (steps 4.7.1 through 4.7.4) may be performed for any of the other output voltage ranges, rather than the 0 to 120 volt range, if desired. In this case, the rear loaded printed circuit board should be rotated to provide the proper output voltage range. The load impedance and output voltage levels should be taken from those given in Table 4-1. Care should be taken to use non-inductive load resistors, especially on the 30 volt and 60 volt output voltage ranges where load impedances are very low and a few microhenries of inductance will significantly influence the power factor at 2 KHz to 5 KHz. The load regulation must remain within a ±1 per cent band from 45 Hz to 2 KHz and within a ±2 per cent band from 45 Hz to 5 KHz on the 60 volt and 240 volt output ranges. The load regulation must remain within a ±1 per cent band from 45 Hz to 1.0 KHz and within a ±2 per cent band from 45 Hz to 2 KHz on the 30 volt range.

NOTE

Care should be taken to insure that the output amplitude of the oscillator remains stable and independent of load conditions during this test.

4.8 AMPLITUDE STABILITY

4.8.1 Connect the Model 1201T Power Source as shown in Figure 4-3. Adjust the AC input line voltage to 230 volts rms. Adjust the output of the power source to provide 115 volts rms output (95.8 per cent of rated output voltage) at 400 Hz. Connect a 11.0 ohm (1200 VA) load to the output terminals at the rear of the power source and check that the REG control has been set to provide a zero output impedance.

4.8.2 Connect an AC expanded scale (about 115 volts rms) strip chart recorder across the output terminals of the power source and record the drift during a 24 hour period. This drift should be less than ±0.29 volts rms. Disregard the drift during the first hour, as this represents initial warm-up drift. Care should be taken to insure that the ambient temperature is held constant at ±3 degrees centigrade for this test.

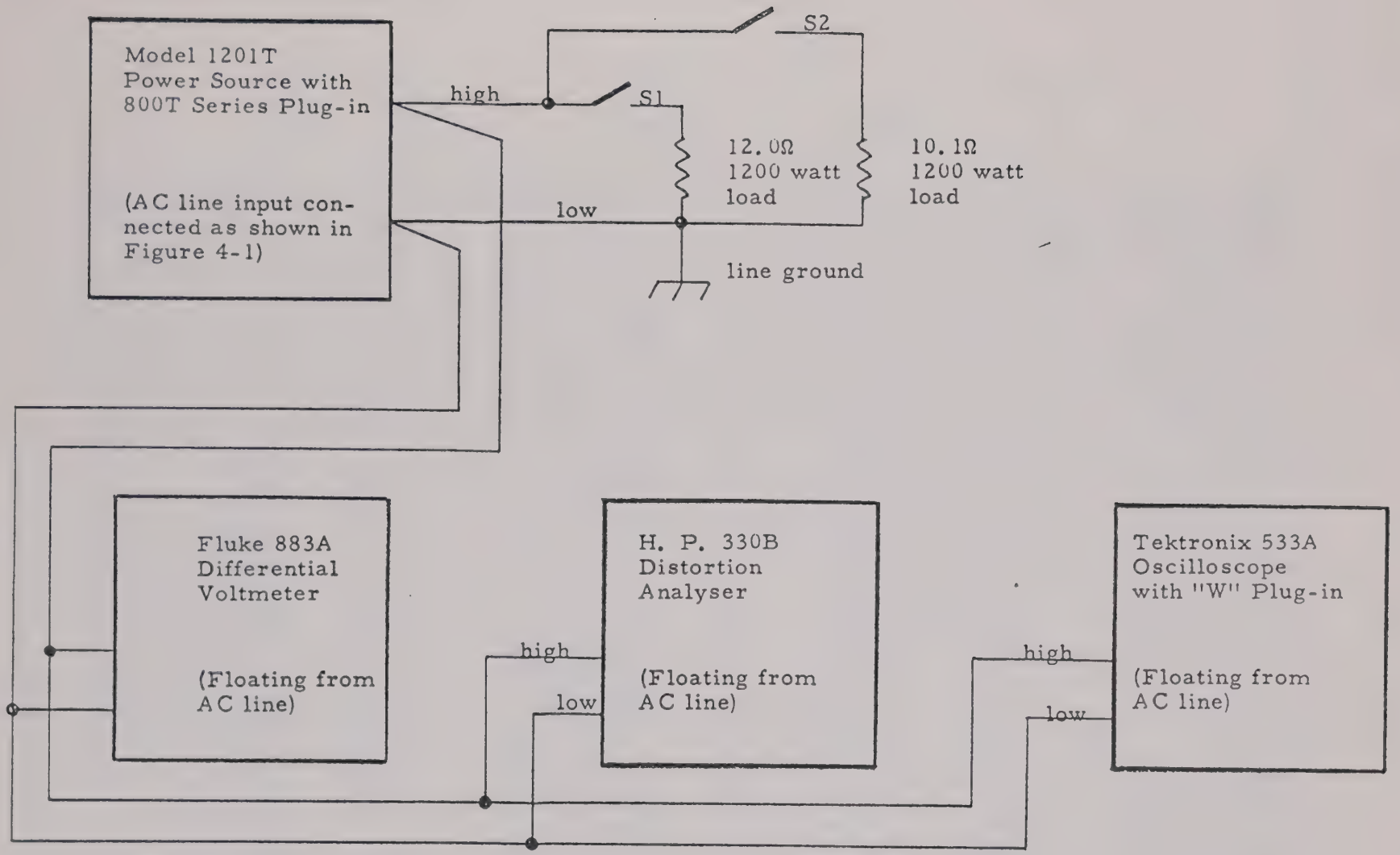


FIGURE 4-3. Test circuit for Model 1201T Power Source.

4.8.3 This procedure may be performed for any of the other output voltage ranges, rather than the 0 to 120 volt range, if desired. In this case, the rear loaded printed circuit board should be rotated to provide the proper output voltage range. The load impedance and output voltage level should be taken from those given in Table 4-1 consistent with the dynamic range of the specific expanded scale strip chart recorder employed for the test.

4.9 FREQUENCY RESPONSE

4.9.1 Connect the Model 1201T Power Source as shown in Figure 4-3. Adjust the input AC line voltage to 230 volts rms. Adjust the output of the power source to provide 120 volts output (100 per cent of rated output voltage) at 400 Hz.

4.9.2 Vary the output frequency of the oscillator from 45 Hz to 5 KHz and monitor the output voltage of the power source with a differential voltmeter under no-load conditions. The output of the power source should vary less than ± 7.11 volts rms from 45 Hz to 5 KHz.

4.9.3 Close switch S1 and repeat 4.9.1 and 4.9.2. The output of the power source should vary less than ±7.11 volts rms from 45 Hz to 5 KHz.

4.9.4 This procedure may be performed for any of the other output voltage ranges, other than the 0 to 120 volt range, if desired. In this case, the rear loaded printed circuit board should be rotated to provide the proper output voltage range. The load impedance and output voltage level should be taken from those given in Table 4-1. The output must vary less than ±0.5 dB from 45 Hz to 5 KHz.

4.10 AC NOISE LEVEL

4.10.1 Connect the Model 1201T Power Source as shown in Figure 4-3. Adjust the line voltage to 230 volts rms. Adjust the output of the power source to provide 110 volts rms (91.6% of rated output voltage) at 400 Hz.

4.10.2 Close switch S2 and monitor the output of the power source with the Tektronix 533A Oscilloscope with a "W" plug-in. Using the offset feature of the "W" plug-in, observe the positive peak of the output voltage at a vertical sensitivity of .2 volt per centimeter and a sweep rate of 5 milliseconds per centimeter. The peak-to-peak noise and ripple should not exceed 0.312 volts (60 dB below full output). The noise and ripple output may be slightly greater if the power source is tested at an output frequency of less than 200 Hz.

4.10.3 Remove the plug-in oscillator and short pins 1 and 2 together of the terminal strip TB1 located on the rear panel of the Model 1201T. The AC rms noise in the output should now be less than 11.0 millivolts rms (80 dB below full output) when read on the differential voltmeter. Remove the short from pins 1 and 2 of TB1 and then insert the plug-in oscillator into the 1201T.

4.10.4 Steps 4.10.1 through 4.10.3 may be performed on any of the other output voltage ranges, if desired. In this case, the rear loaded printed circuit board should be rotated to provide the proper output voltage range. The load impedance and output voltage level should be taken from those given in Table 4-1. The following chart gives the acceptable noise level output on each voltage range.

Rated Output Voltage	30V AC	60V AC	120V AC	240V AC
Peak-to-Peak Noise Level with 1200 VA Load (See 4.10.2)	0.078Vp-p	0.156Vp-p	0.312Vp-p	0.624Vp-p
RMS Noise Level at No Load (See 4.10.3)	2.75 mv rms	5.5 mv rms	11.0 mv rms	22 mv rms

4.11 0.7 LAGGING POWER FACTOR

4.11.1 Connect the Model 1201T Power Source as shown in Figure 4-3. Select the load circuit to correspond with the required output voltage range. Figure 4-4 illustrates the load circuit and gives load parameter values for 1200 VA 0.7 power factor at 400 Hz with 91.6 per cent of rated output voltage from the power source. This represents the worst case inductive load for maximum power dissipation inside the power source.

4.11.2 Set the oscillator frequency to 400 Hz and adjust the GAIN control for 91.6 per cent of rated output voltage. Check that the power source produces a stable output with no high-frequency oscillation or excessive distortion. Refer to Section 4.5 of this instruction manual for the procedure to measure harmonic distortion. This distortion must be less than 0.3 per cent at 400 Hz. The overload adjustments, A1R54 and A1R57, may have to be rotated counterclockwise slightly with a 0.7 power factor load to meet the 0.3 per cent distortion specification.

4.11.3 The REG control usually does not require significant readjustment in order to provide a zero regulation with a 0.7 power factor load at 400 Hz. If the unit is to be operated at a 0.7 power factor in the high frequency region, i.e., 2 KHz to 5 KHz, then it may be necessary to readjust the REG control. In this case, rotate the front panel REG control until zero regulation is obtained at the specific frequency and load condition.

4.11.4 The AC input power is 4200 watts maximum with an 0.7 power factor load at 91.6 per cent of rated output voltage and an input line voltage of 250 volts rms.

4.11.5 The above tests may be repeated at frequencies other than 400 Hz provided that the inductance of the series inductor is changed inversely proportional to the absolute value to the test frequency. For example, at 1 KHz the inductance value must be divided by 2.5. The series resistance value remains unchanged.

4.12 0.7 LEADING POWER FACTOR

4.12.1 Connect the Model 1201T Power Source as shown in Figure 4-3. Select the load circuit to correspond with the required output voltage range. Figure 4-5 illustrates the load circuit and gives load parameter values for 1200 VA 0.7 power factor operation at 400 Hz with 91.6 per cent of rated output voltage from the power source. This represents the worst case capacitive load for maximum power dissipation inside the power source.

4.12.2 Set the oscillator frequency to 400 Hz and adjust the GAIN control for 91.6 per cent of the rated output voltage. Check that the power source produces a stable output with no high frequency oscillation or excessive distortion. Refer to Section 4.5 for the procedure to measure harmonic distortion. This distortion must be less than 0.3 per cent at 400 Hz. The overload adjustments, A1R54 and A1R57, may have to be rotated counterclockwise slightly with a 0.7 power factor load to meet the 0.3 per cent distortion specification.

4.12.3 The REG control usually does not require significant readjustment in order to provide a zero regulation with a 0.7 power factor load at 400 Hz. If the unit is to be operated at a 0.7 power factor in the high frequency region, i.e., 2 KHz to 5 KHz, then it may be necessary to readjust the REG control. In this case, rotate the front panel REG control until zero regulation is obtained at the specific frequency and load condition.

4.12.4 The AC line input power is 4200 watts maximum with an 0.7 power factor load at rated output voltage and an input line voltage of 250 volts rms.

4.12.5 The above tests may be repeated at frequencies other than 400 Hz provided that the capacitance of the series capacitor is changed inversely proportional to the absolute value of the test frequency. For example, at 1 KHz the capacitance value must be divided by 2.5. The series resistance value remains unchanged.

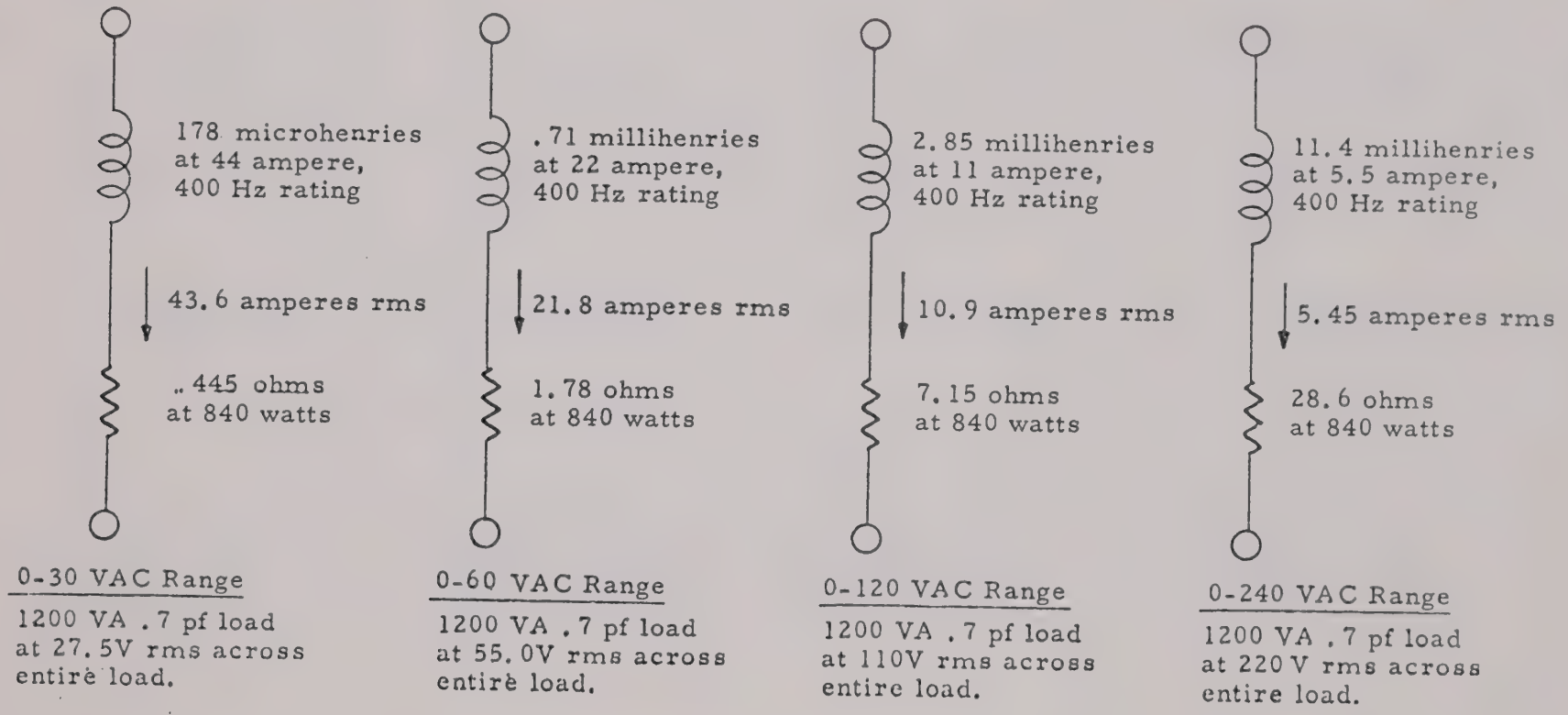


FIGURE 4-4. Load Circuit for 0.7 Lagging Power Factor at 400 Hz.

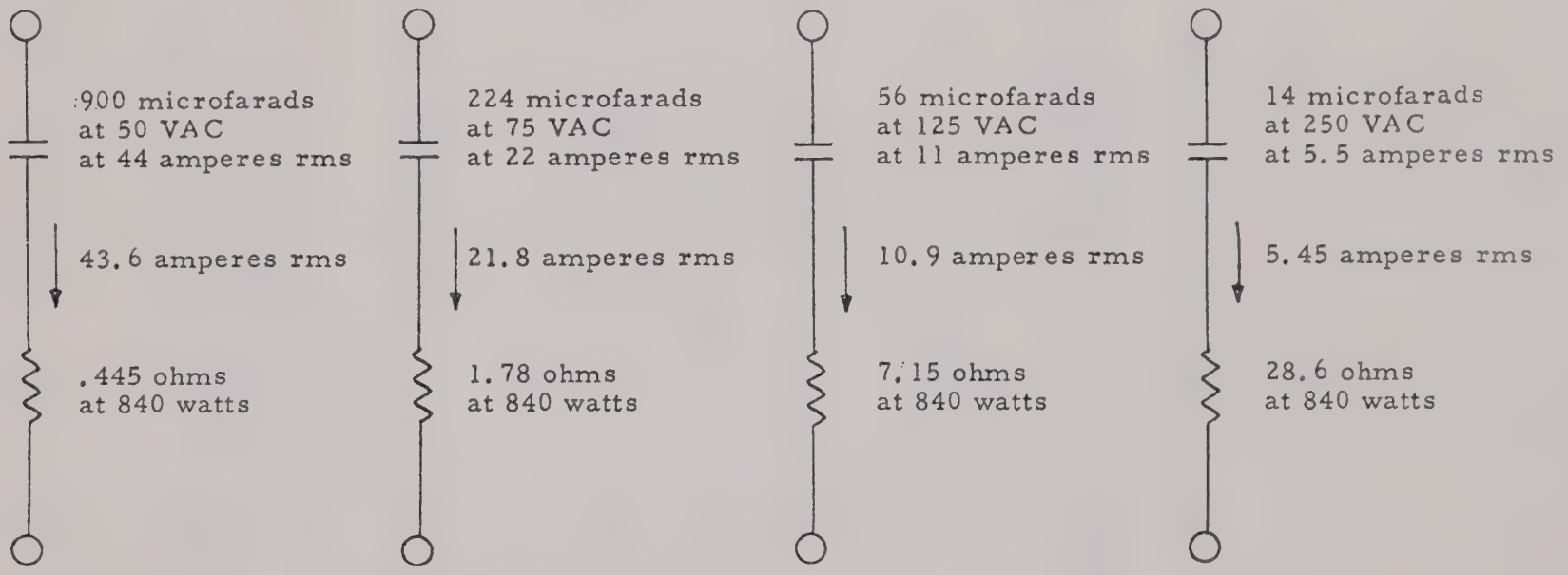


FIGURE 4-5. Load Circuit for 0.7 Leading Power Factor at 400 Hz.

5.1 GENERAL

The California Instruments Model 1201T Power Source is a solid state unit and should require a minimum of maintenance. However, it is forced air cooled and will accumulate some dust with time. The power transistor heatsinks should receive a forced air bath at intervals not to exceed six months.

CAUTION

Failure to keep the heatsinks clean will reduce their thermal transfer efficiency somewhat and could cause failure of the power source.

5.2 TROUBLESHOOTING

5.2.1 If a problem appears in the power source, it must be isolated to a specific section of the unit. Before servicing the amplifier, check that the AC power input to the unit is of the proper amplitude and frequency. Check that the signal input to the power amplifier is also of the proper amplitude (approximately 5 volts rms) and frequency (45 Hz to 5 KHz). Check that the output load on the power amplifier is not excessive or that the load starting transients are not excessive. Check that the output of the oscillator is coupled to the input of the power amplifier through the 12 pin connector on the rear of the power amplifier.

5.2.2 If the problem has been resolved to be in the power amplifier, first check all DC power supply voltages. Information concerning power supply ripple and voltage tolerance is given in Section 3.2.8 of this instruction manual.

5.2.3 Check that the quasi complementary symmetry output amplifier is operating properly and is not drawing excessive current under no load conditions. Section 3.2.2 of this instruction manual describes the operation of this output amplifier.

5.2.4 Check that the overload circuitry is operating properly. The overload circuit may be disabled by removing A1CR13 and A1CR14.

5.2.5 If the problem has been resolved to be in the oscillator, consult the applicable oscillator instruction manual.

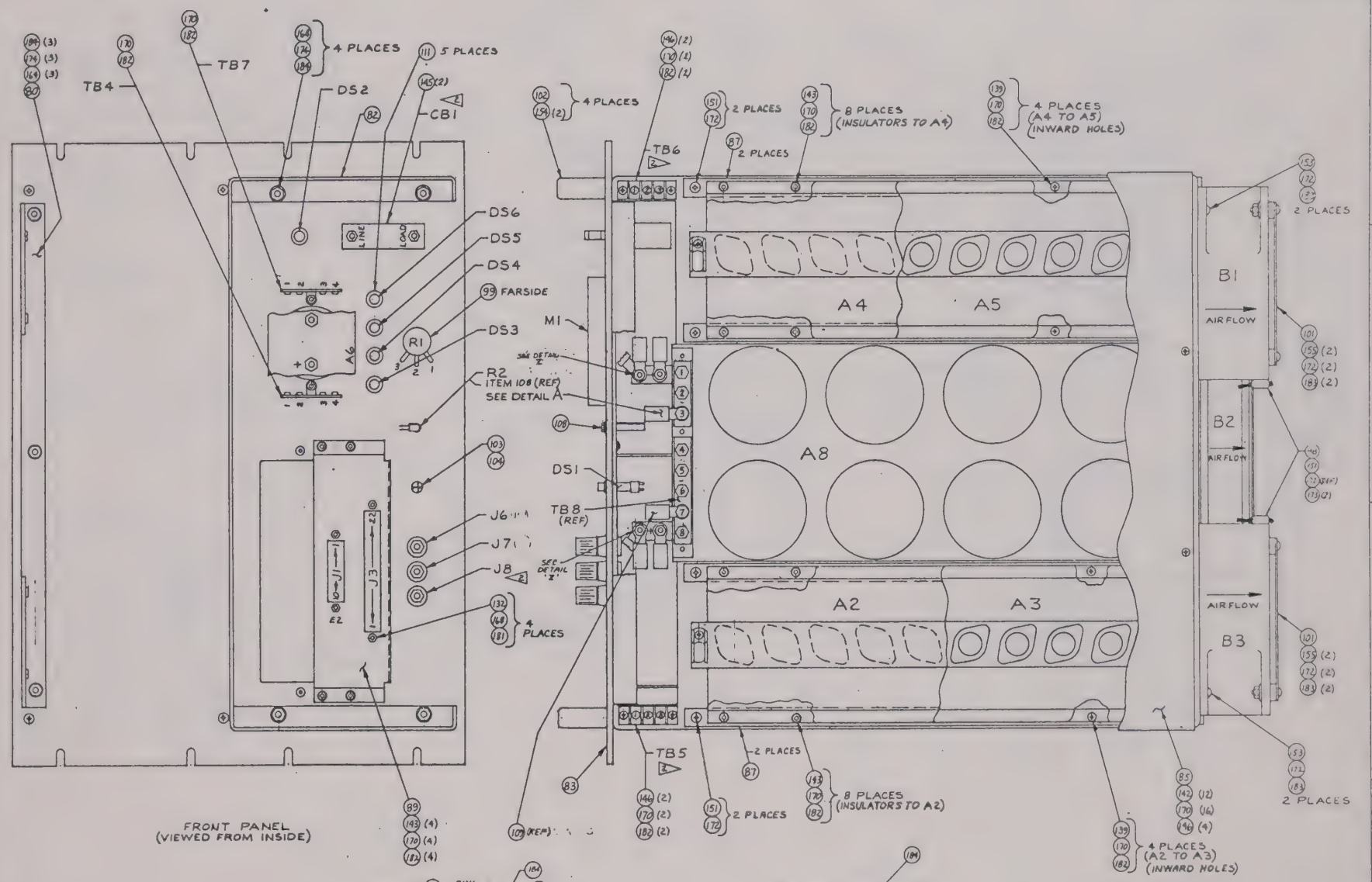
6.1 GENERAL

This section contains schematics and mechanical diagrams necessary for operation and maintenance of the Model 1201T AC Power Source. The schematic diagrams illustrate the circuit while the mechanical assemblies indicate the part placement.

6.2 REFERENCE DESIGNATIONS

Partial reference designators are shown on schematic and mechanical drawings. Prefix these reference designators with assembly and/or sub-assembly designation for the complete reference designator. For example:

Assembly/Sub-Assembly	Component	Component Designation
A1	C14	A1C14
None	T1	T1
A2	R1	A2R1

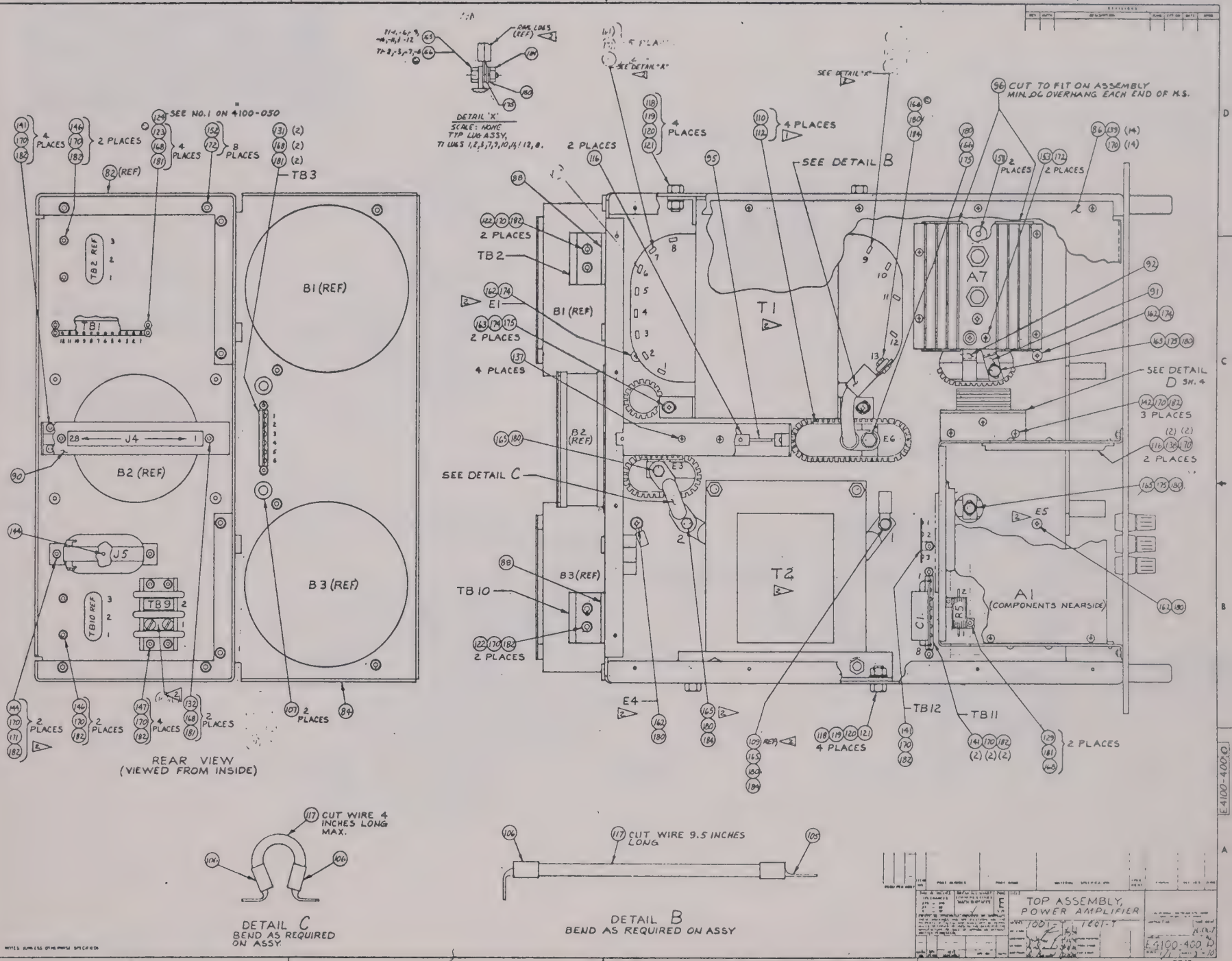


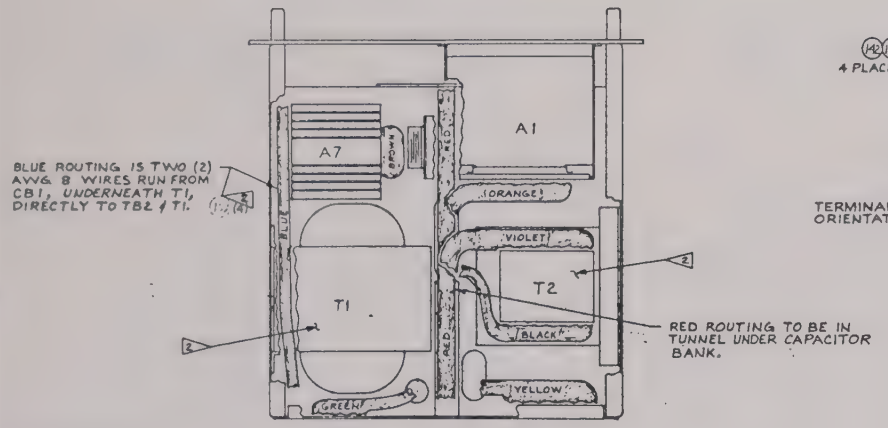
6. SECURE WIRES TO TERM 1 & TERM 2 PIGTAIL BY SHRINK TUBING OR BLACK ELEC. TAPE IN AREA SHOWN.
5. ROTATE B1, B2 & B3 SO WIRE TERMINALS ARE ADJACENT TO GROMMET FOR INTERNAL WIRING.
4. FOR WIRE TAB TABLE SEE DWG NO. A100-050
3. FOR SCHEMATIC SEE DWG NO. E4100-070
2. AFTER WELDING ONLY USE SPECIFIC CRIMP LUG REQUIREMENTS.
1. CUT [illegible] TO ITEM [illegible] USING [illegible] WIRE

FOR PARTS LIST SEE SHEETS 4 & ON.

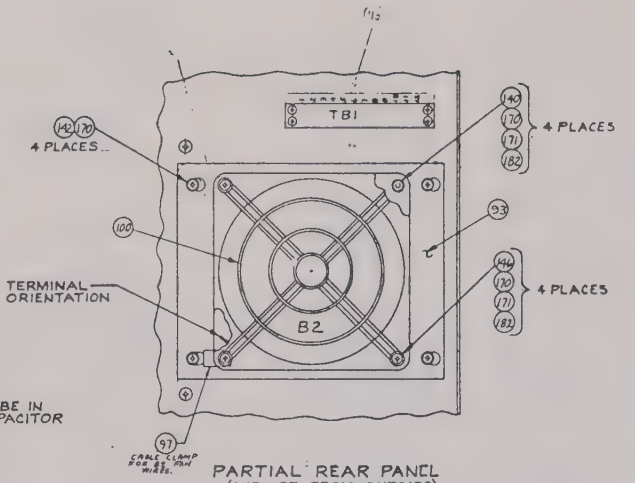
TOP ASSEMBLY POWER AMPLIFIER

E4100-4001 (D)

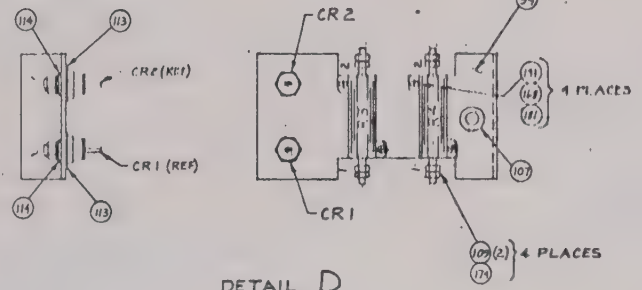

DETAIL 'X'
SCALE: NONE
TYP LUG ASSY,
T1 LUGS 1,2,3,7,9,10,14, 12, 8.
SEE DETAIL 'X'
SEE DETAIL B
SEE DETAIL C
SEE DETAIL D SH. 4
SEE NO. 1 ON 4100-050
CUT TO FIT ON ASSEMBLY MIN. .06 OVERHANG EACH END OF H.S.
TB1
TB2
TB3
TB9
TB10
TB11
TB12
J4
J5
B1 (REF)
B2 (REF)
B3 (REF)
T1
T2
A1
A7
E1
E3
E4
E5
E6
REAR VIEW
(VIEWED FROM INSIDE)
DETAIL C
BEND AS REQUIRED ON ASSY.
DETAIL B
BEND AS REQUIRED ON ASSY
CUT WIRE 4 INCHES LONG MAX.
CUT WIRE 9.5 INCHES LONG
TOP ASSEMBLY, POWER AMPLIFIER
4100-400



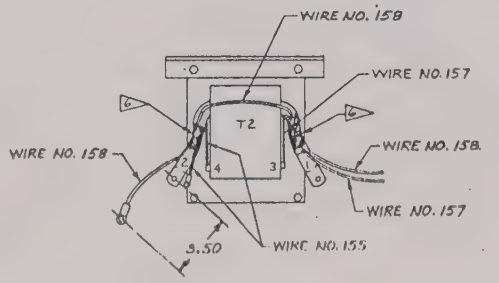
WIRE ROUTING



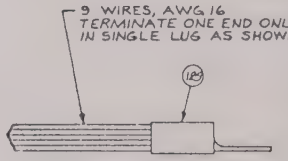
PARTIAL REAR PANEL
(VIEWED FROM OUTSIDE)



DETAIL D
(SEE SHEET 3)



DETAIL F
T2 CRITICAL WIRING.
WIRE NO'S SHOWN ARE FOUND ON WIRE TAB TABLE, DRAWING NO. 4100-050

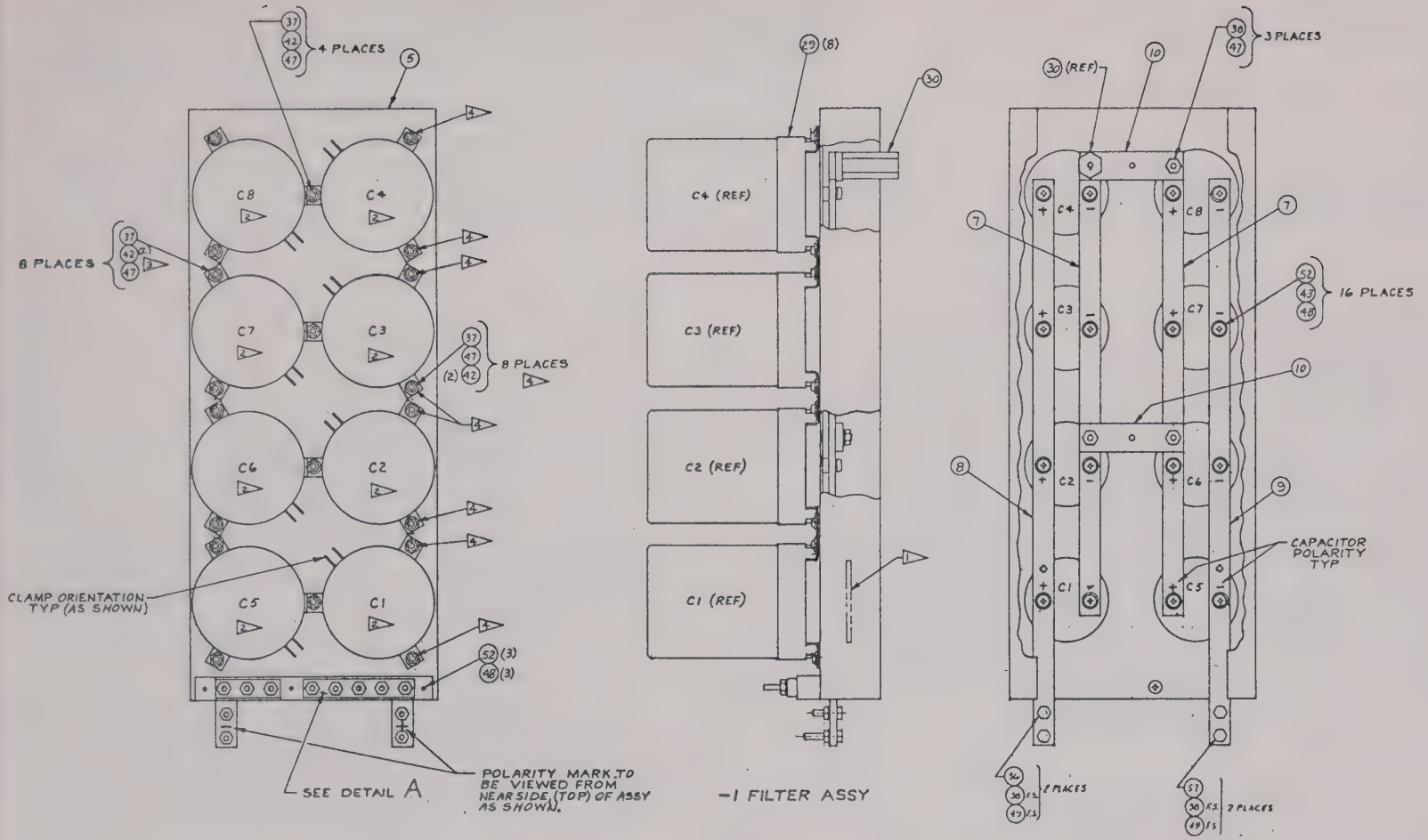


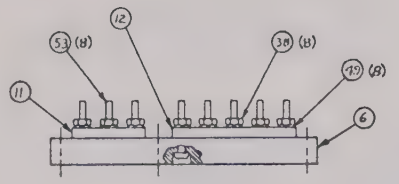
DETAIL E
(REF WIRE TAIL TABLE DWG. NO. 4100-050)
SCALE: NONE

	PART NUMBER	PART NAME	MATERIAL – SPECIFICATION	QUAN	FINISH
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES; TOLERANCES: .XX = ±.03, .XXX = ±.010, ANGLES = ±2°; BREAK SHARP EDGES .005 MAX; REMOVE BURRS AND FLASH; INTERPRET DIMENSIONS AND TOLERANCES PER ANSI Y14.5M-1982; MATERIAL OR FINISH SUBSTITUTIONS MUST BE APPROVED BY ENGINEERING DEPARTMENT					

TITLE: TOP ASSEMBLY, POWER AMPLIFIER
SIZE: E
DRAWING NO.: E4100-400
REV: D
SCALE: NONE
WEIGHT: 46.06 LBS
SHEET 1 OF 3

E4100-400 D





DETAIL A

INSTALL C1, C2, C3 & C4 NEXT USING ONE (1) FLAT WASHER, (ITEM NO. 42), AS SPACER BETWEEN CLAMP FOOT & SURFACE OF CHASSIS ON ALL FEET FLAGGED

INSTALL C5, C6, C7 & C8 FIRST WITH CAPACITOR CLAMP BEING FLUSH WITH TOP SURFACE OF CHASSIS, (ITEM NO. 5)

ALL CAPACITOR CANS TO BE INSTALLED FLUSH WITH TOP SURFACE OF CHASSIS, (ITEM NO. 5)

METAL STAMP ASSY PART NO. APPROX. AS SHOWN (NEAR SIDE)

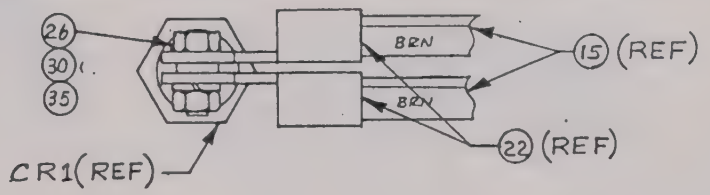
FOR PARTS LIST SEE SHEET 3 & ON

FILTER ASSY A8

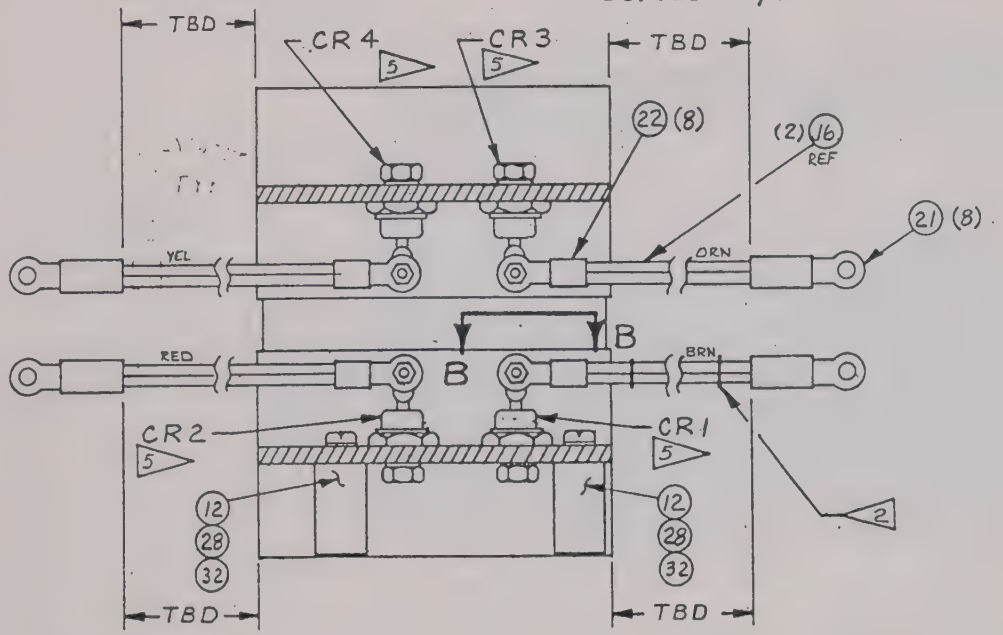
E4100-401 A

E4100-401-A

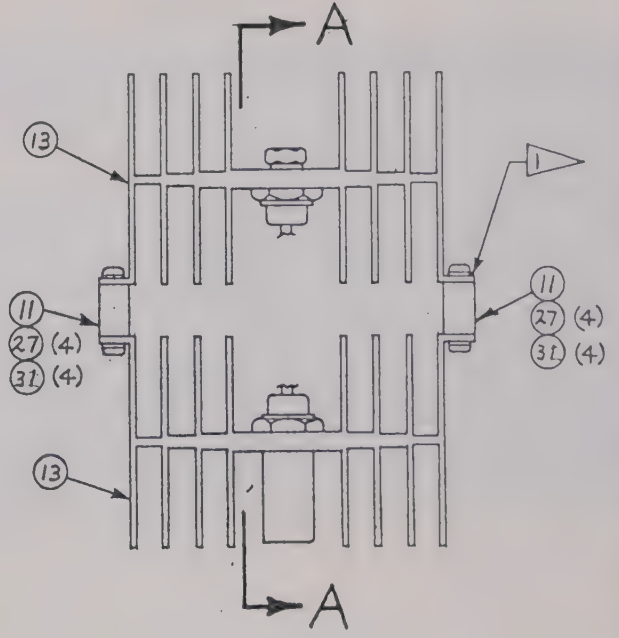
REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



SECTION B-B
(TYP 4 PLACES)
SCALE: 2/1



SECTION A-A



-1 ASSY

5 APPLY ITEM 18 (THERMATE SILICONE COMPOUND) BETWEEN DIODES & HEATSINK.

4. FOR SCHEMATIC SEE DWG E4100-070.

2 COMMON WIRES TO BE LACED TOGETHER

1 METAL STAMP ASSY PART NO. ON TOP SIDE OF FLANGE AS SHOWN.

NOTES: (UNLESS OTHERWISE SPECIFIED)

FOR PARTS LIST, SEE SHEET 3

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

DIM IN INCHES TOLERANCES XXX = .010 XX = .03 X° = 30'

BREAK ALL SHARP CORNERS & EDGES MACH SURFACES √

DWG SIZE C

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

TITLE: HEATSINK ASSY, RECTIFIER DIODE A7

CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

MODEL 1001-T ; 1201-T

CONTRACT NO.

CODE IDENT 16067

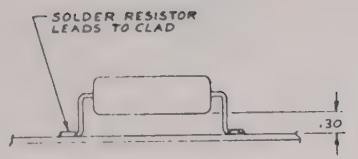
RELEASE			PURCHASING
CHECKER	[illegible]	10/6/72	
DESIGN	R.A. Dowd	10/6/72	PROJ ENGR
DRFTSMN	R.A. Dowd	10/6/72	ENGR

DWG NO. C4100-402 REV C

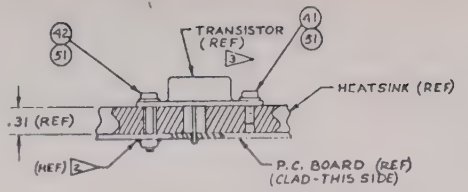
SCALE 1/1 SHEET 2 OF 3

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH
-1	1	E4100-400-1		

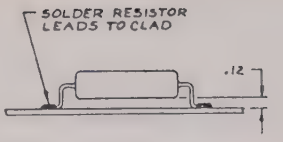
C4100-402 C



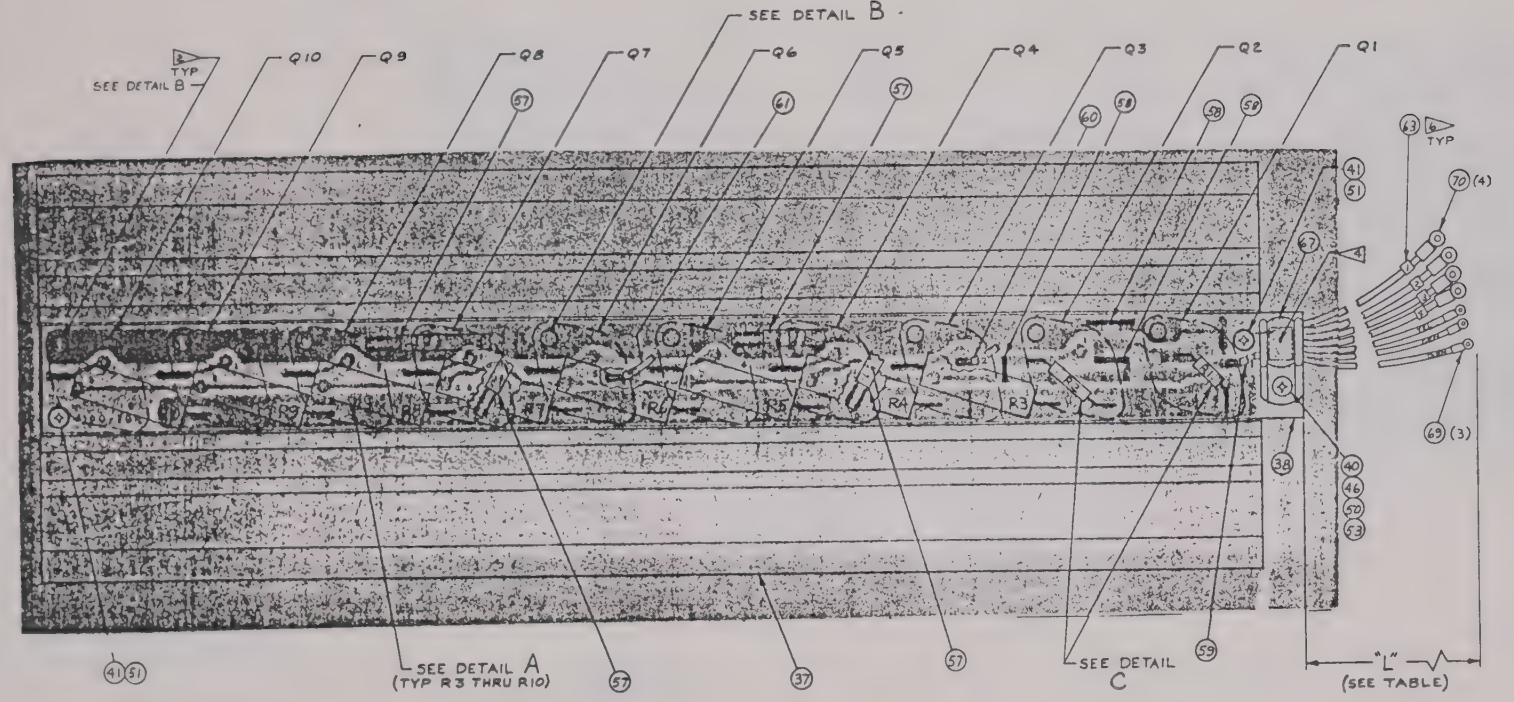
DETAIL A
(TYP R3 THRU R10)

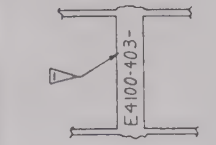


DETAIL B
(TYP TRANSISTOR MOUNTING)



DETAIL C
(TYP FOR R1 & R2)





END VIEW OF HEATSINK (FOR IDENT LOCATION)

WIRE TAB TABLE

WIRE NO OR COLOR	FROM PAD NO	WIRE GAUGE AND COLOR	ITEM NO.	"L" (LENGTH IN INCHES)
YEL	1	AWG 18 - YEL	59	5.5
ORN	2	AWG 18 - ORN	60	5.5
3	3	AWG 10 - WHT	57	8.0
1	4	AWG 10 - WHT	57	8.0
GRN	5	AWG 18 - GRN	61	5.5
4	6	AWG 10 - WHT	57	8.0
2	7	AWG 10 - WHT	57	8.0

1. IDENTIFY WIRES 1 THRU 4. COORDINATE WITH WIRE TAB TABLE.
5. FOR SCHEMATIC SEE DRAWING NO. E4100-070 (FOR -1) & E4150-070 (FOR -2)
6. ASSEMBLY REF DES, "A2", TO BE MARKED ON FARSIDE OF ITEM 32 IN AREA SHOWN, USING WHITE INK.
7. APPLY ITEM 65 BETWEEN TRANSISTORS & HEATSINK.
8. SOLDER CLINCH NUT TO CLAD. (TYP 10 PLACES)
9. METAL STAMP ASSY PART NO. APPROX. AS SHOWN.

UNLESS OTHERWISE SPECIFIED

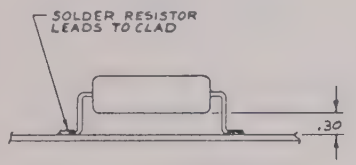
FOR PARTS LIST - SEE SHEETS 3 & ON

ITEM	PART NUMBER	PART NAME	MATERIAL - SPECIFICATION	CODE IDENT	FINISH	QTY REQ	ZONE
ASSD PER ASSY NO							

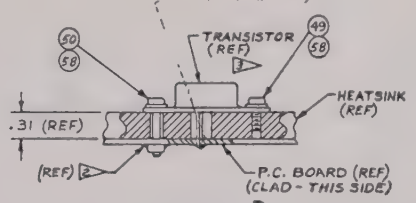
SIZE E	HEATSINK ASSY, DRIVER	A2	
			V6047
			E4100-403 D
			SHT 2 OF 5

E4100-403-D

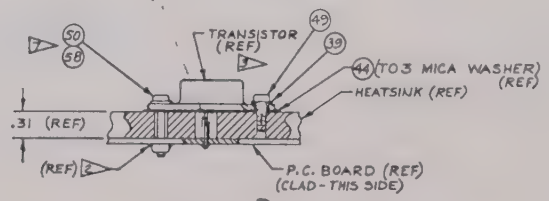
A



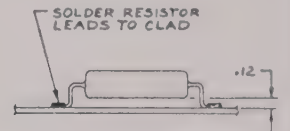
DETAIL A
(TYP R3 THRU R10)



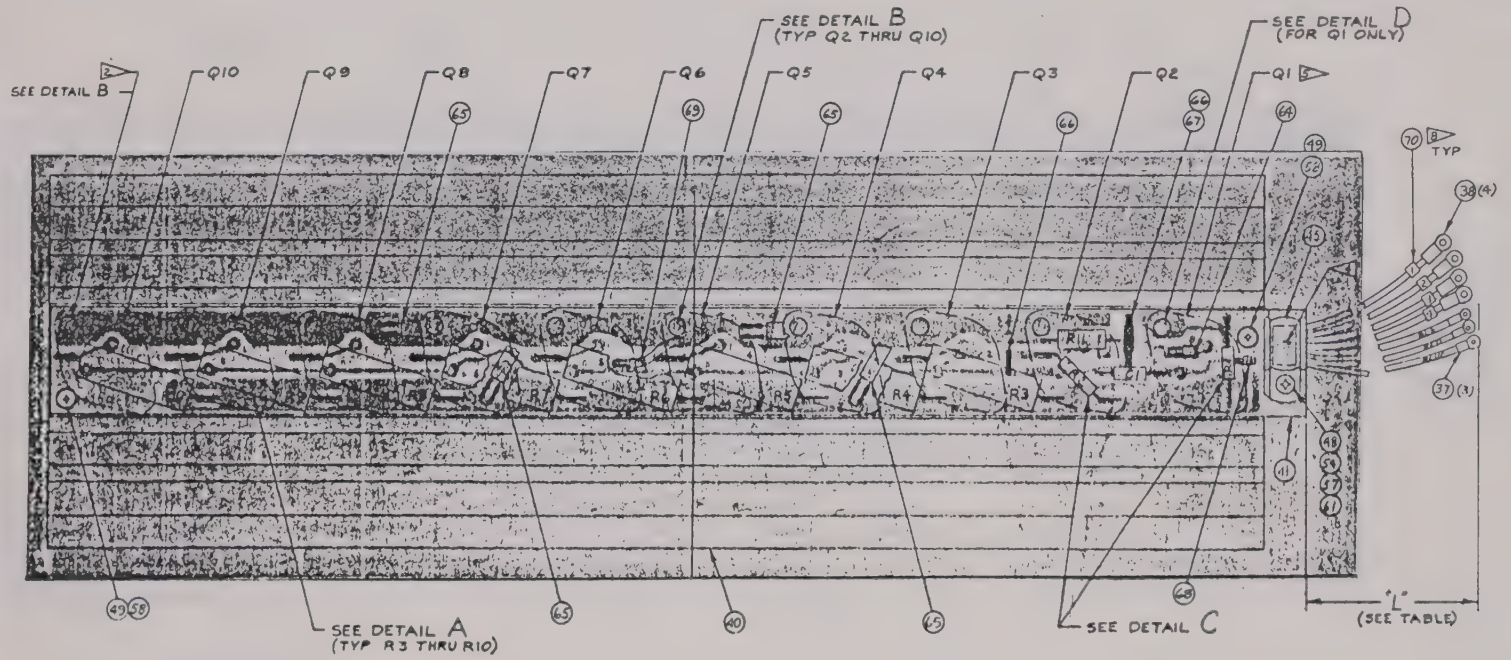
DETAIL B
(TYP Q2 THRU Q10)



DETAIL D
(FOR Q1 ONLY)



DETAIL C
(TYP FOR R1 & R2)



END VIEW OF HEATSINK
(FOR IDENT LOCATION)

2 IDENTIFY WIRES 1 THRU 4. COORDINATE WITH WIRE TAB TABLE.

3 ITEM 50 TO BE INSULATED FROM HEATSINK, USING TEFLON SLEEVING. (FOR Q1 ONLY)

6 FOR SCHEMATIC SEE DRAWING NO. E4100-070 (FOR -1) (E4150-070 (FOR -2)

5 Q1 MUST BE INSULATED FROM HEATSINK PER DETAIL D.

4 ASSEMBLY REF DES "A4" TO BE MARKED ON FARSIDE OF ITEM 32 IN AREA SHOWN, USING WHITE INK.

1 APPLY ITEM 43 BETWEEN TRANSISTORS & HEATSINK

8 SOLDER CLINCH NUT TO CLAD (TYP 10 PLACES)

WIRE TAB TABLE

WIRE NO OR COLOR	FROM PAD NO	WIRE GAUGE AND COLOR	ITEM NO.	"L" (LENGTH IN INCHES)
INK	1	AWG 18 - BLK	68	5.5
3	3	AWG 10 - WHT	65	8.0
1	4	AWG 10 - WHT	65	8.0
RED	5	AWG 18 - RED	69	5.5
4	6	AWG 10 - WHT	65	8.0
2	7	AWG 10 - WHT	65	8.0
BLUE	8	AWG 18 - BLU	64	5.5

FOR PARTS LIST - SEE SHEETS 3 & ON

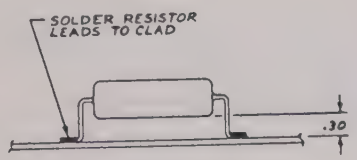
E

HEATSINK ASSY, DRIVER

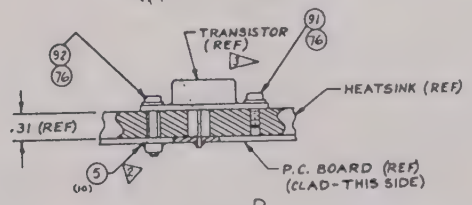
A4

TOOL 1601-1, 1601-2

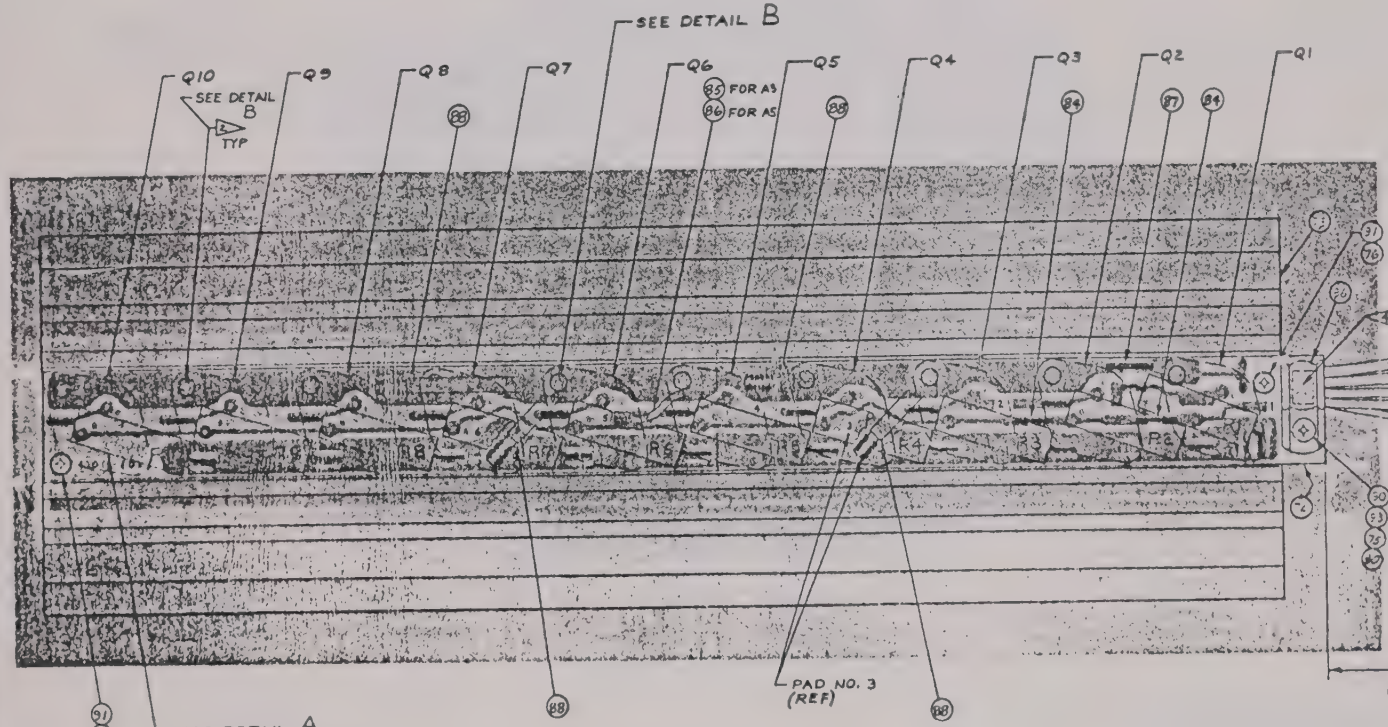
E4100-454-D

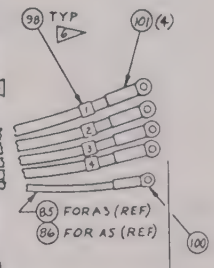


DETAIL A
(TYP RESISTOR MOUNTING)

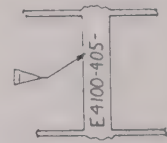


DETAIL B
(TYP TRANSISTOR MOUNTING)





"L" (SEE TABLE)



END VIEW OF HEATSINK (FOR IDENT LOCATION)

-1 ASSEMBLY A3 (+26.5V)
-2 ASSEMBLY A5 (-26.5V)
-3 ASSEMBLY A3 (+26V)
-3 ASSEMBLY A5 (-26V)

WIRE TAB TABLE

WIRE NO. OR COLOR	FROM PAD NO.	WIRE GAUGE AND COLOR	ITEM NO.	FOR ASSY	"L" (LENGTH IN INCHES)
3	3	AWG 10 - WHT	88	-1 / -3	A3 8.0
3	3	AWG 10 - WHT	88	-2 / -3	A5 8.0
1	4	AWG 10 - WHT	88	-1 / -3	A3 8.0
1	4	AWG 10 - WHT	88	-2 / -3	A5 8.0
GRN	5	AWG 18 - GRN	85	-1 / -3	A3 5.5
RED	5	AWG 18 - RED	86	-2 / -3	A5 5.5
4	6	AWG 10 - WHT	88	-1 / -3	A3 8.0
4	6	AWG 10 - WHT	88	-2 / -3	A5 8.0
2	7	AWG 10 - WHT	88	-1 / -3	A3 8.0
2	7	AWG 10 - WHT	88	-2 / -3	A5 8.0

△ IDENTIFY WIRES 1 THRU 4. COORDINATE WITH WIRE TAB TABLE

5 △ FOR SCHEMATIC SEE DRAWING NO. E4100-070 (FOR -1/-2) / E4150-070 (FOR -3)

△ ASSEMBLY REF DES TO BE MARKED IN WHITE INK, ON FARSIDE OF ITEM 59 IN AREA SHOWN. (REF DES ARE "A3" OR "A5")

△ APPLY ITEM 97 BETWEEN TRANSISTORS AND HEATSINK

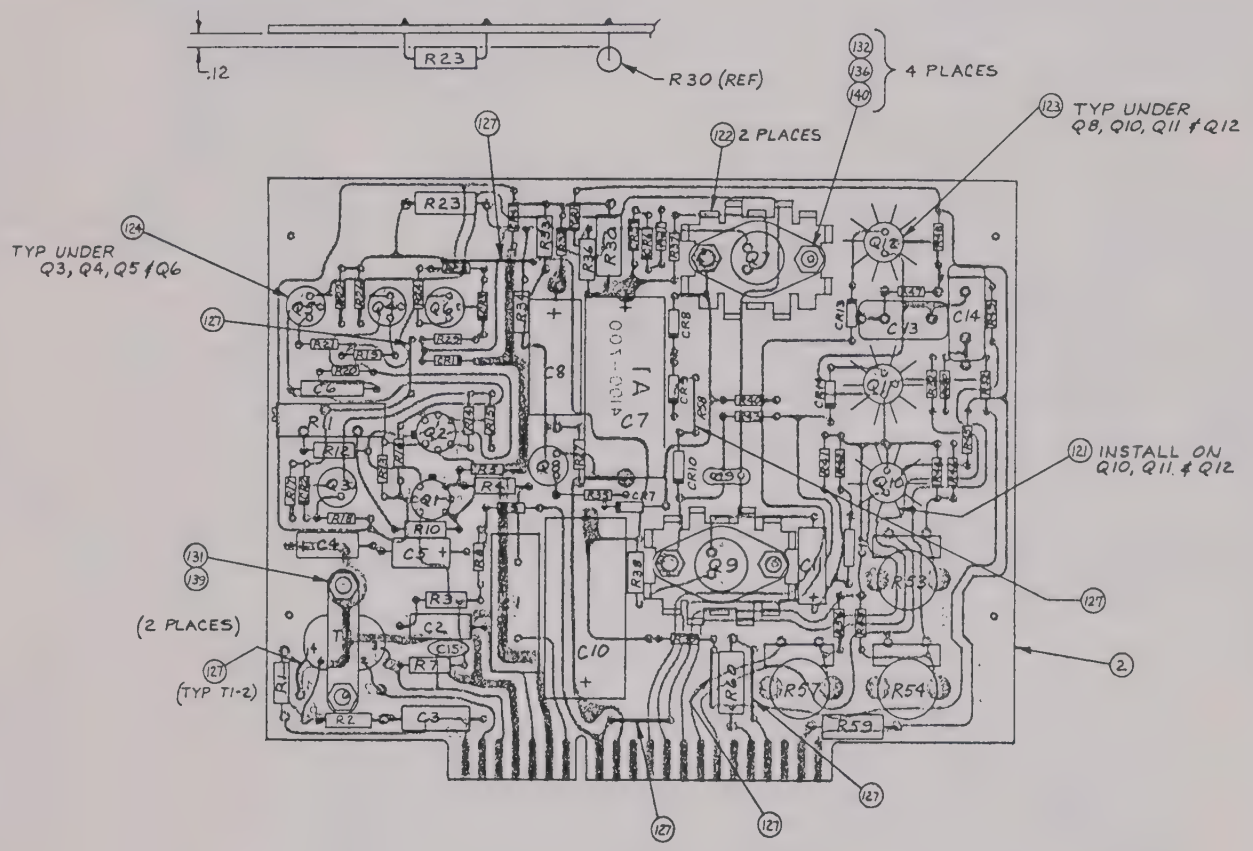
△△ INSTALL ITEM 5 AT AC SIDE USING ISM TOOL NOS CP14F1, CP14, AND CP1491 MAN. OR EQUIV. PRESSURE WORKERS SOLDER CLINCH NUTS TO CLAD.

FOR PARTS LIST - SEE SHEETS 2 / 3 / 4

HEATSINK ASSY. OUTPUT POWER A3 A5

E4100-405

E4100-405E



-1 P.C. BOARD ASSY

2. REF DES. R6, R25, & CR12 NOT USED.
1. FOR SCHEMATIC SEE DWG NO. D4100-071.

NOTES (UNLESS OTHERWISE SPECIFIED)

FOR PARTS LIST SEE SHEET 4 & ON

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	ECO NO	DATE	APPD
		SEE SHEET 1				

ITEM NO.	PART NUMBER	PART NAME	MATERIAL – SPECIFICATION	COOL IDENT	FINISH	REF DES	ZONE
REQD PER ASSY							

DIM IN INCHES TOLERANCES .XXX = .010 .XX = .03 X° = 30°
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓
DWG SIZE D

TITLE: P.C. BOARD ASSY, PREAMPLIFIER A1

MODEL 100LT ; 120LT ; 150LT

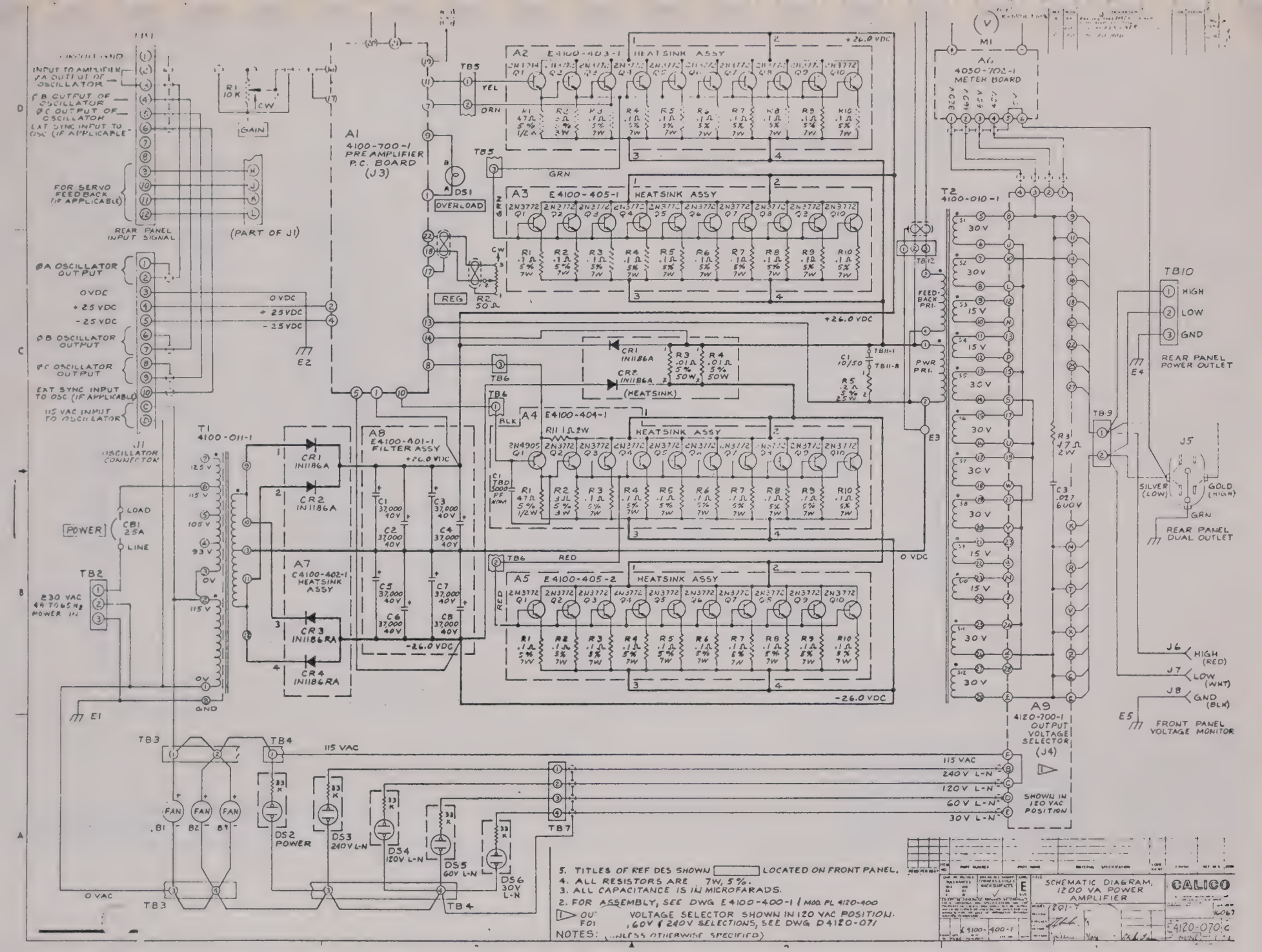
CONTRACT NO | CODE IDENT 16067

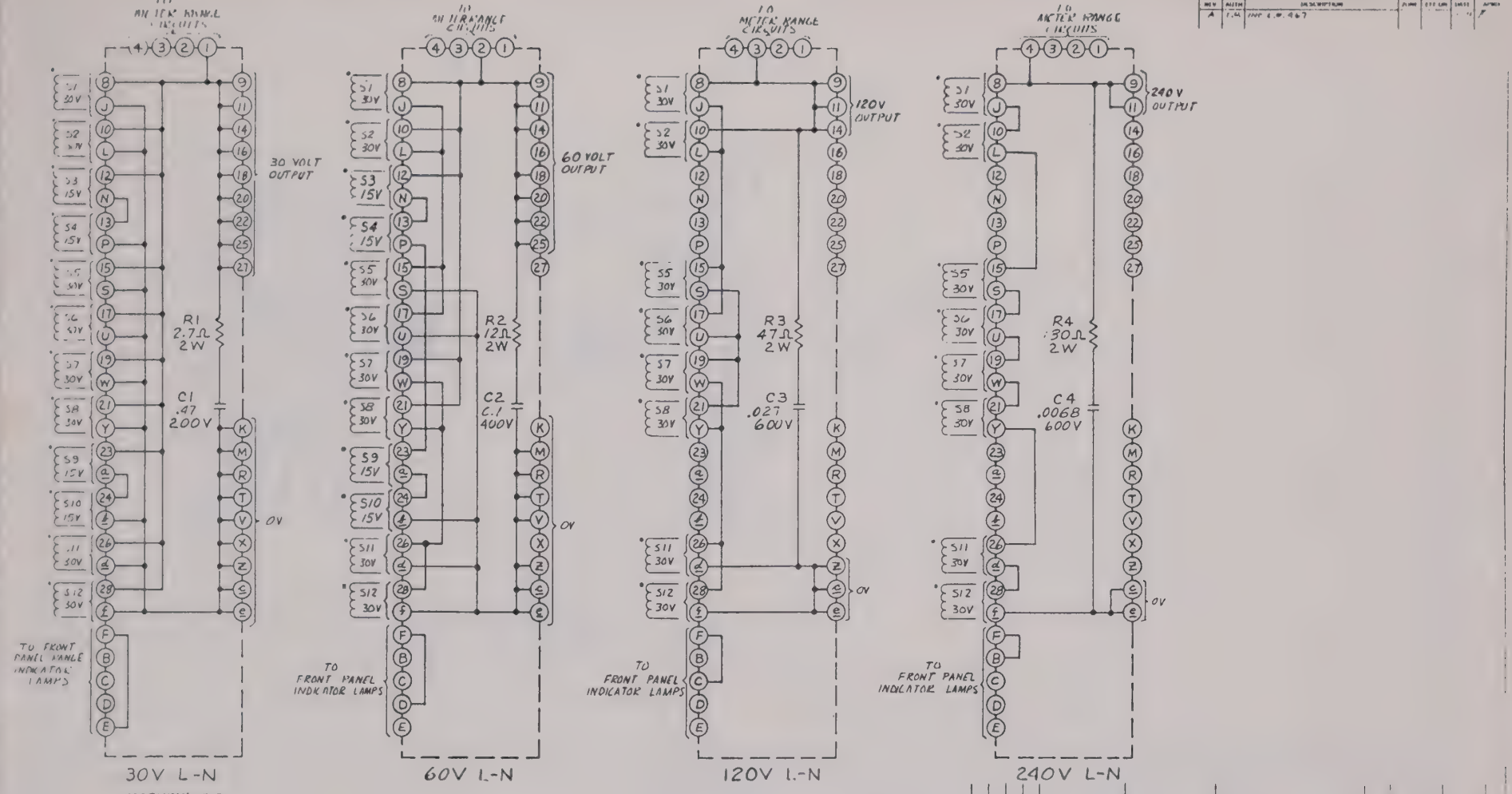
DWG NO D4100-700 | REV 3

SCALE 2/1 | SHEET 2 OF 7

RELEASE | CHECKED | DESIGNED | DRAWN | APPROVED

D4100-700 3


A1 4100-700-1 PRE AMPLIFIER P.C. BOARD (J3)
A2 E4100-403-1 HEAT SINK ASSY
A3 E4100-405-1 HEATSINK ASSY
A4 E4100-404-1 HEATSINK ASSY
A5 E4100-405-2 HEATSINK ASSY
A6 4050-702-1 METER BOARD
A7 C4100-402-1 HEATSINK ASSY
A8 E4100-401-1 FILTER ASSY
A9 4120-700-1 OUTPUT VOLTAGE SELECTOR (J4)
T1 4100-011-1
T2 4100-010-1
J1 OSCILLATOR CONNECTOR
TB1
TB2
TB3
TB4
TB5
TB6
TB7
TB9
TB10
TB11
TB12
R1 10K CW GAIN
R2 50Ω REG
R3 47Ω 2W
R4 .01Ω 5% 50W
R5 2Ω 5% 25W
R11 1Ω 2W
C1 10/50
C1 TBD 5000 MF MIN
C3 .027 600V
CR1 IN1186A
CR2 IN1186A
CR3 IN1186RA
CR4 IN1186RA
CB1 25A
DS1 OVERLOAD
DS2 POWER
DS3 240V L-N
DS4 120V L-N
DS5 60V L-N
DS6 30V L-N
FAN B1
FAN B2
FAN B3
M1
E1
E2
E3
E4
E5
INPUT TO AMPLIFIER VIA OUTPUT OF OSCILLATOR
FB OUTPUT OF OSCILLATOR
ØC OUTPUT OF OSCILLATOR
EXT SYNC INPUT TO OSC (IF APPLICABLE)
FOR SERVO FEEDBACK (IF APPLICABLE)
REAR PANEL INPUT SIGNAL
(PART OF J1)
ØA OSCILLATOR OUTPUT
0 VDC
+25 VDC
-25 VDC
ØB OSCILLATOR OUTPUT
ØC OSCILLATOR OUTPUT
EXT SYNC INPUT TO OSC (IF APPLICABLE)
115 VAC INPUT TO OSCILLATOR
230 VAC 4Ø TO 65 ~ POWER IN
POWER
LOAD
LINE
FEEDBACK PRI.
PWR PRI.
(HEATSINK)
+26.0 VDC
-26.0 VDC
0 VDC
115 VAC
240 V L-N
120 V L-N
60 V L-N
30 V L-N
SHOWN IN 120 VAC POSITION
0 VAC
REAR PANEL POWER OUTLET
REAR PANEL DUAL OUTLET
FRONT PANEL VOLTAGE MONITOR
HIGH
LOW
GND
SILVER (LOW)
GOLD (HIGH)
GRN
J6 HIGH (RED)
J7 LOW (WHT)
J8 GND (BLK)
5. TITLES OF REF DES SHOWN [ ] LOCATED ON FRONT PANEL.
4. ALL RESISTORS ARE 7W, 5%.
3. ALL CAPACITANCE IS IN MICROFARADS.
2. FOR ASSEMBLY, SEE DWG E4100-400-1 / MOD. PL 4120-400
OUTPUT VOLTAGE SELECTOR SHOWN IN 120 VAC POSITION.
FOR 60V & 240V SELECTIONS, SEE DWG D4120-071
NOTES: (UNLESS OTHERWISE SPECIFIED)
SCHEMATIC DIAGRAM, 1200 VA POWER AMPLIFIER
CALICO
E4120-070-C



2. CORRELATE WITH UNIT SCHEMATIC NO. E4120-070(FOR 1201T) OR E4150-070(FOR 1501T)
1. FOR P.C. BOARD, SEE DWG NO. 4120-700

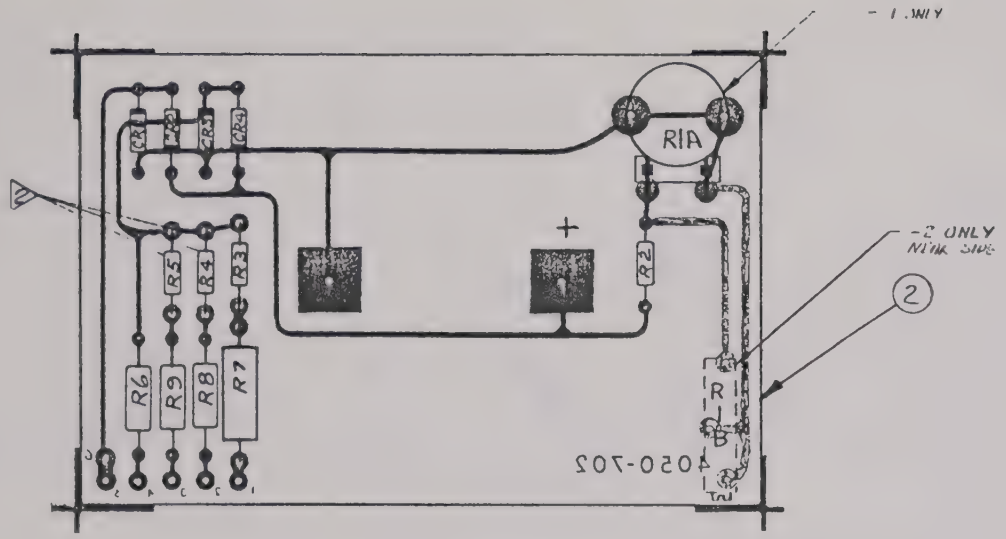
NOTES (UNLESS OTHERWISE SPECIFIED)

REV	AUTH	DESCRIPTION	ZONE	ECO NUM	SHEET	APPROV
A	F.M.	PER E.C.O. 467				

ITEM NO	PART NUMBER	PART NAME	MATERIAL SPECIFICATION	LOCATION	FINISH	REF DES	ZONE
IN NEXT HIGHER ASSY							

DIM IN INCHES TOLERANCES .XXX ± .010 .XX ± .02 .X ± .1
UNLESS OTHERWISE SPECIFIED ALL SHARP CORNERS & EDGES MACH SURFACES ✓
SIZE D DWG NO
TITLE SCHEMATIC DIAGRAM, OUTPUT VOLTAGE SELECTOR PRINTED CIRCUIT BOARD
CALICO
MODEL 1201T/1501T
CONTRACT NO 16067
RELEASE
CHECKED
DESIGN
DRAWN
DASH NO | QTY REQD | NEXT ASSEMBLY | EFF ON | AUTH
DWG NO D4120-071 REV A
MATL NONE SHEET 1 OF 1

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



A6

-1 ASSEMBLY

VIEWED FROM COMPONENT SIDE

C4050-70. C

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
REQD PER ASSY	PL 4050-702	PARTS LIST ON SHEET 4					

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

DIM IN INCHES
TOLERANCES
XXX = .010
XX = .03
X° = 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE C

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

TITLE
VOLTMETER
P.C. BOARD ASSY

MODEL 501-T (A6)

RELEASE

CHECKER	Wemer	7/15/64	PURCHASING
DESIGN			PROJ ENGR
DRFTSMN	B. Dener	7/7/64	CHF ENGR

CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CONTRACT NO.

CODE IDENT 16067

DWG NO. C4050-702 REV C

SCALE 2/1 SHEET 2 OF 4

CALICO F-168

A6

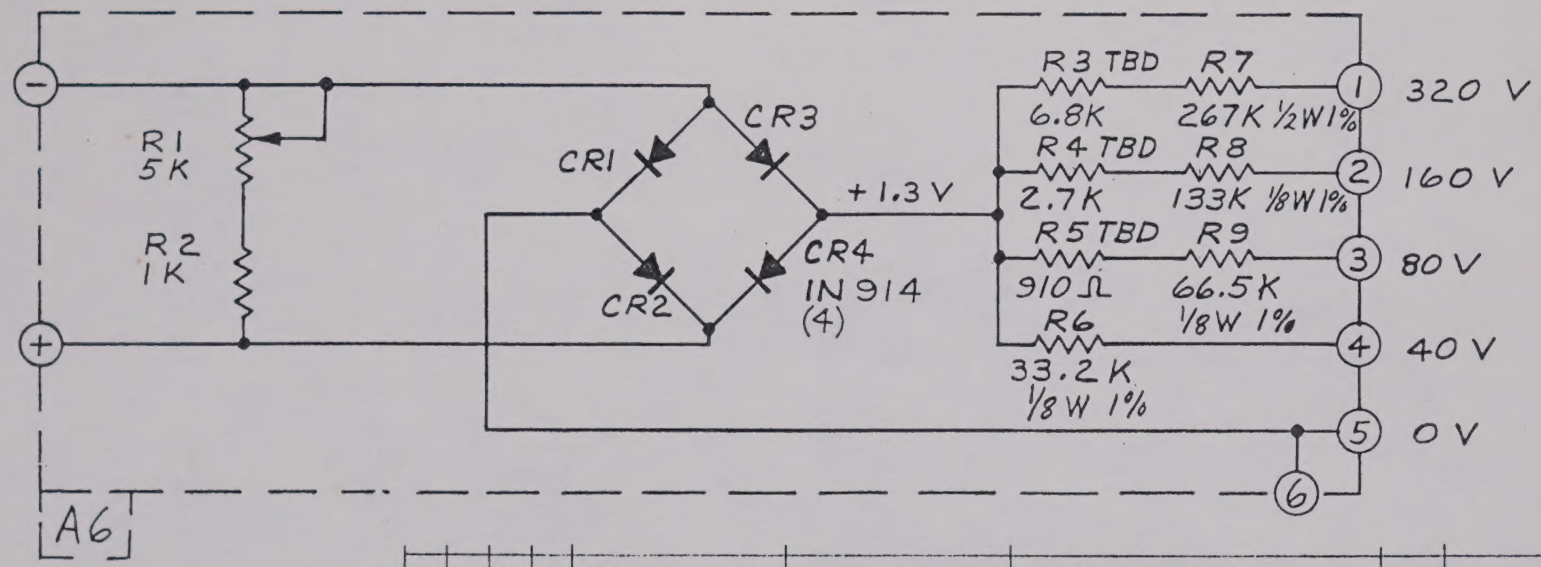
MOUNT R3, R4, & L5 1ST SIDE.

1. FOR SCHEMATIC SEE DWG NO. B 4050-072

NOTES: (UNLESS OTHERWISE SPECIFIED)

B4050-072 A

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD
A		ADDED EYELET NO.6 Danes			12/16/69	



REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

3. PREFIX "A6" TO BE USED WITH ALL REF DES. (EXAMPLE: A6R1)
2. FOR ASSY SEE D4050-702
1. ALL RESISTORS ARE ¼W 5%

NOTES: (UNLESS OTHERWISE SPECIFIED)

DIM IN INCHES TOLERANCES
.XXX = .010
.XX = .03
X° = 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE B

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

TITLE
SCHEMATIC DIAGRAM VOLTMETER P.C. BD.

MODEL ALL "T" SERIES AC INVERTRONS

RELEASE	[illegible]	11/7/69			
CHECKER	[illegible]	7/15/69	PURCHASING		
DESIGN			PROJ ENGR		
DRFTSMN	D. Danes	5/6/69	CHF ENGR		

DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH

CALIFORNIA INSTRUMENTS CORP.
SAN DIEGO, CALIFORNIA

CONTRACT NO.

CODE IDENT 16067

DWG NO. B4050-072 REV A

SCALE NONE SHEET 1 OF 1

CALICO F-101

MP MASTER
MA28346